CHAPTER 2

Literature Review

The study entitled on "An Evaluation of the Lower Secondary School Mathematics Teacher Competency" was conducted on the basis of researching on relevant documents and previous research which were presented in order as follows.

    2.1 The Basic Education Core Curriculum B.E. 2551 regarding Mathematics Learning Areas in the Lower Secondary School

    2.2 Concepts of Teacher Competency and Mathematics Teacher Competency

    2.3 Concepts of Evaluation, Evaluation Model Development, Development of Elements and Indicators, and Personnel Evaluation

    2.4 Guidelines in Developing and Enhancing Teacher Competency

    2.5 Related Research

The details gained from studying concepts, theories, documents, and related research were as follows.

2.1 The Basic Education Core Curriculum B.E. 2551 regarding Mathematics Learning Areas in the Lower Secondary School

2.1.1 The concepts regarding the Basic Education Curriculum B.E. 2551

The Tenth National Economic and Social Development Plan (2007-2011) accentuated the need to move the focus of human development. It got to be basic for the Thai people to be blessed with desirable moral values, intelligence and keenness. They were supposed to be able to appreciate full development in all regards – physical, intellectual, emotional and spiritual. They would thus be able to alter themselves to unavoidable change, prompting a transformation to a solidly-established knowledge-based society. The direction of such human capacity development would concentrate on furnishing children and young people with a firm establishment for achieving morality and public-mindedness, together with capacities, skills and fundamental knowledge essential to their future lives, prompting sustainability in national development (Office of the National Economic and Social Development Board, 2006). Such needs were steady with the policy of the Ministry of Education in controlling Thai children and adolescents towards the 21st century. Accentuations were set on morality, inclination for Thai-ness, aptitudes in analytical and imaginative thinking, technological know-how, capacity for teamwork and capacity to live in peace and agreement in the world community (Ministry of Education, 2008).

Studies, checking and assessment of application of the Basic Education Curriculum 2001, together with controlling standards of the Tenth National Economic and Social Development Plan for human capacity development, as well as needs pushed by the Ministry of Education for youth development for the 21st century prompted to revision of this curriculum. Consequently, the Basic Education Core Curriculum 2008 was defined for greater clarity and appropriateness. Improvement was made for presentation of objectives and procedure of actualizing the curriculum at educational service area and school levels. Brief vision, objectives, learners' significant capacities, and desirable characteristics were also determined. The Basic Education Core Curriculum therefore recommended mathematics learning areas as follows (Ministry of Education: 2008).

2.1.2 Element characteristics of mathematics learning areas

The learning areas of mathematics consisted of a knowledge body, skills or learning processes, and desirable attributes. They required all students in the basic education level to study. Learning mathematics was to apply knowledge, skills, and mathematics knowledge to solve problems in their lives, to further their studies, to possess reasoning, to possess good attitude toward mathematics, and to develop thoughts systematically and creatively.

2.1.3 The importance of learning mathematics

Mathematics was exceedingly important to the development of the human personality. It empowered a person to procure skills in creativity, rationale and efficient and deliberate thinking, and permits one to carefully and thoroughly investigate various problems or circumstances, envision, plan, make decisions, solve problems and precisely and appropriately apply mathematics in daily life. Mathematics served as a device for learning science, innovation, and other disciplines. It was therefore useful to one's life, improved quality of life, and empowered a person to live in congruity with others.

2.1.4 What was realized in mathematics?

The learning area for mathematics was gone for empowering all children and young people to persistently learn this subject in accordance with their potentiality. The contents prescribed for all learners were as follows.

1. Numbers and operations: numerical concepts and sense of perception; real number system; properties of real numbers; operation of numbers; ratio; percentage; problem-solving involving numbers; and application of numbers in real life

2. Measurement: length; distance; weight; area; volume and capacity; money and time; measuring units; estimation for measurement; trigonometric ratio; problem-solving regarding measurement; and application of measurement in various situations

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3. Geometry: geometric figures and properties of one-dimensional geometric figures; visualization of geometric models; geometric theories; and geometric transformation through translation, reflection and rotation

4. Algebra: pattern; relationship; function; sets and their operations; reasoning; expression; equation; equation system; inequality; graph; arithmetic order; geometric order; arithmetic series; and geometric series

5. Analysis and probability: determining an issue; writing questions; determining methods of study; study; data collection, systematization and presentation; central tendency and data distribution; data analysis and interpretation; opinion polling; probability; application of statistical knowledge and probability; application of probability in explaining various situations as well as for facilitating decision-making in real life

6. Mathematical skills and processes: problem-solving through diverse methods; reasoning; communication; communication and presentation of mathematical concepts; linking mathematics with other disciplines; and attaining ability for creative thinking

2.1.5 Learning areas and learning standards of mathematics

The Basic Education Core Curriculum determined learning standards of mathematics learning areas as follows.

Strand 1: Numbers and operations

Standard M 1.1:

Understanding diverse methods of presenting numbers and their application in real life

Standard M 1.2:

Understanding results of operations of numbers, relationships of operations, and application of operations for problem-solving

Standard M 1.3:

Use of estimation in calculation and problem-solving.

Standard M 1.4:

Understanding of numerical system and application of numerical properties

Strand 2: Measurement

Standard M 2.1:

Understanding the basics of measurement; ability to measure and estimate the size of objects to be measured

Standard M 2.2:

Solving measurement problems

Strand 3: Geometry

Standard M 3.1:

Ability to explain and analyse two-dimensional and three-dimensional geometric figures

Standard M 3.2:

Ability for visualization, spatial reasoning and application of geometric models for problem-solving

Strand 4: Algebra

Standard M 4.1:

Understanding and ability to analyse pattern, relation and function

Standard M 4.2:

Ability to apply algebraic expressions, equations, inequalities, graphs and other mathematical models to represent various situations, as well as interpretation and application for problem-solving

Strand 5: Data Analysis and Probability

Standard M 5.1:

Understanding and ability to apply statistical methodology for data analysis

Standard M 5.2:

Application of statistical methodology and knowledge of probability for valid estimation

Standard 5.3:

Application of knowledge of statistics and probability for decision-making and problem-solving

Strand 6: Mathematical Skills and Processes

Standard M 6.1:

Capacity for problem-solving, reasoning, and communication; communication and presentation of mathematical concepts; linking various bodies of mathematical knowledge and linking mathematics with other disciplines; and attaining ability for creative thinking

2.1.6 Quality of mathematics students

At the point when students graduated Grade 9, the mathematics students' quality was as follows.

1. Understand concepts of numbers, ratio, proportion, percentage, real numbers expressed in exponential notation with integer indices, square root and cube root of real numbers; have the capacity to complete operations including integral numbers, fractions, decimals, exponents, square roots and cube roots of real numbers; have the capacity to apply numerical knowledge in actuality.

2. Have knowledge and comprehension of surface areas of prisms and cylinders, and volume of prisms, cylinders, pyramids, cones and spheres; have the capacity to suitably choose units of the various systems of measuring length, area, and volume; and have the capacity to apply knowledge of measurement in real life.

3. Be ready to develop and clarify stages of constructing two-dimensional geometric figures with compass and straight edge; have the capacity to explain characteristics and properties of three dimensional geometric figures, i.e., prisms, pyramids, cylinders, cones and spheres.

4. Understand properties of congruence and similarities of triangles, parallels, Pythagoras' theorems and converse; be able to apply these properties for reasoning and problem-solving; and understand geometric transformation through translation, reflection and rotation.

5. Have the capacity to visualize and clarify characteristics of two-dimensional and three dimensional geometric figures.

6. Have the capacity to analyze and clarify connections of patterns, situations or problems; and have the capacity to use single-variable linear equations, two-variable linear equation systems, single-variable linear inequality, and graphs in problem-solving.

7. Have the capacity to focus an issue, compose questions around a problem or a situation, determine methods of study and collect and present data by utilizing pie charts or any other forms of presentation.

8. Understand concepts of the measures of central tendency, arithmetic mean, median, and mode of non-frequency distribution data that could be chosen appropriately for application, as well as apply knowledge in considering statistical data and information.

9. Understand the concepts of random sampling and probability; have the capacity to apply knowledge of probability for projecting and for decision-making in distinctive circumstances.

10. Have the capacity to apply diverse methods for problem-solving; avail mathematical and technological knowledge, skills and processes appropriately to solve problems confronted in distinctive circumstances; have the capacity to suitably provide reasoning for decision-making and appropriately present the conclusion reached; have the capacity to utilize mathematical language and symbols for communication; have the capacity to communicate and present mathematical concepts accurately and clearly; be able to link various bodies of mathematical knowledge; have the capacity to link mathematical knowledge, principles and processes with other disciplines; and have achieved capacity for creative thinking.

According to the aforementioned parts, it was summarized that the Basic Education Core Curriculum B.E. 2551 and the curriculum of mathematics learning areas were improved to possess more quality in order to be clear in operating to develop mathematics competency elements of students, especially the key competency that teachers had to operate teaching and learning so that the students possessed these key competency aspects.

2.2 Concepts of Teacher Competency and Mathematics Teacher Competency

2.2.1 Competency concepts

The concepts of competency in what factors were supposed to be in the necessary concepts of competency were presented in details as follows.

According to David McClelland's concept of competency, individual contrast was compared with an iceberg. Knowledge and skill competency in the individuals tended to be effortlessly unmistakable gliding over the water. Most undetectable parts were under the water, for example motives, traits, self-image, and social roles. They were more difficult to be evaluated and developed in spite of the fact that they influenced individual practices more. On other words, these parts were social role, a role individuals communicated toward others; self-image, emotions and contemplations towards characteristics and value of their own; traits, the habitude or rehashed behaviors in a specific structure; and motives, imagination or patterns of intuition and behaving methods normally of that individual (the Office of the Civil Service Commission: 2005, 2-4). That at first glance involved intelligence. That an individual possessed capacity in learning and aptitudes was not sufficient for empowering him to yield extraordinary operational results.

2.2.1.1 Definition of Competency

Competency or competence was defined by many scholars as follows.

Good (1973: 121) defined competency as skills, concepts, and attitude required in all performance. It was considered a type of ability that applied concepts, theories, and techniques in various fields to use in actual situations and solve problems ultimately.

Boyatzis (1982: 58) defined competency in that competency included both internal and external constraints, environment, and relationships related to a job or occupation. Motivations and perceptions of work were viewed as influential in competently and successfully performing in a position.

Spencer and Spencer (1993: 9-11) mentioned that competency was an underlying characteristic of an individual that was casually related to criterion-referenced effective

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and superior performance in a job or situation. Derived from this definition, five types of competency characteristics was generalized which were (1) motives, (2) traits, (3) self-concept which was a person's attitude, values, or self-image), (4) knowledge, and (5) skills.

Aporn Phuwittayapan (1998: 27) defined competency that it was an expressing behavior of human beings which reflected knowledge, skills, and personal attributes in distinctive manners.

Danai Thienput (2000: 56-57) mentioned that competency was a group of abilities in individuals which determined individual behaviors in order to achieve work requirement under organizational environment enabling personnel to required performance.

Narongwith Santhong (2003: 27) stated that competency was an ability of those in that position. Competency did not limit only the behavior but penetrate deeply to cover belief, attitude, and hidden characteristics of people as well.

Anon Sakrawit (2004: 61) summarized that competency was individual personality which was knowledge, skills, ability, and other qualification, such as value, morality, personality, physical appearance, and others which were necessary and in accordance with an office appropriateness.

Scott B. Parry (1996: 48, cited in Tien Tongkaew, 2006: 2) defined competency as the interrelated group of knowledge, skills, and attributes and was influential to the main duties of certain organizational position. This interrelated group of knowledge, skills, attributes was correlated to the outcomes or the results of the duties in the position. This correlation could be measured and compared to the acceptable standards, and the group of knowledge could be created through trainings and development.

Jetsada Prakobsarp (2007: 29) defined competency as individual attributes indicating the personnel performance which was outstanding in any task.

Prajak Sapudom (2007: 3) mentioned that competency was knowledge, skills, and personal characteristics of attributes contributing to behavior which was necessary and

influential toward the individual performance in having responsibilities better than others.

Sompotch Noppakun (2007: 48) defined competency as knowledge, ability, and behavior which was proper with the work and in accordance with determined job positions.

Dale and Hes (1995: 80) stated that competency was a discovery for what contributed to performance excellence or superior performance. Moreover, they defined occupational competence as an ability in doing various activities in their professions so as to operate as expected in the standards.

O'Hagen (1996: 4-5) mentioned that competency was a concept that could transfer, move, or mobilize skills and knowledge to new situations regarding the work. This concept was found generally in an organization during planning, new changes, and temporary activities. It also included the quality of possessing efficiency among personnel in their offices.

Parry (1996: 48-56) stated that a competency was a cluster of related knowledge, skills, and attitudes that affected a major part of one's job (a role or responsibility), that correlated with performance on the job, that could be measured against well accepted standards, and could be improved via training and development.

McLangan (1997: 40-47) communicated his opinions toward competency characteristics in distinctive dimensions, including competency one which consolidated inputs and outputs together.

 1. Competency as tasks: many job descriptions and methodologies were task-oriented, notwithstanding when the tasks were not called competencies. The task perspective was a consequence of many years of separating work into manageable activities and procedures keeping in mind the end goal to decrease the amount of thinking required, to eliminate performance variability, and to spread best practices.

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2. Competency as results: this kind of competency was rarer than task competencies. Adding the words ability to an outcome, for example the ability to deliver profits, made what a few individuals called a competency.

3. Competency as outputs: an output was something that a person or team created, provided, or delivered. Adding ability to an output made it a competency.

4. Competency as knowledge, skill, and attitude: this competency characterized the core capacities required for effective performance in a given job.

5. Competency as attribute bundle: a bundle of attributes or attribute bundle was a mark for a gathering of knowledge, abilities, and attitudes or tasks, outputs, and results. This half breed type of competency commonly utilized such terms as initiative, problem solving, and decision making. Those areas contained a few components.

2.2.1.2 Elements of competency

Spencer and Spencer (1993: 21-23) proposed that in taking competency to be determined a competency level in order to measure performance abilities of personnel. There were three elements as follows.

1. Competency cluster: a competency cluster was an accumulation of firmly related competencies. The competencies distinguished or developed through the given methodologies were classified into clusters. The competencies could be assembled through distinctive arrangements, for example assignment competencies, initiative competencies, administrative competencies, and intuition competencies.

2. Dimensions: this was a competency dimension covering genuine yearning and necessities craved, an effect size toward people, behavioral intricacy ventures, exertion, and work character. At that point, these were utilized to determine the numbers of dimensions for each competency. Basically, a specific competency comprised of 2-3 dimensions.

3. Competency level: this was a clarification of competency. By and large, there were three levels of competency which were positive behavior, negative behavior, and neutral behavior. Each behavioral aspect lay in every dimension.

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According to the aforementioned part, it could be seen that the competency elements based on Spencer and Spencer's concepts reflected the performance characteristics and were considered successful keys leading to the desired operational results. This enabled an organization to inspect what aspects the personnel still lacked which needed accurately modified and developed.

Parry (1996: 48-56) gave suggestions regarding element and competency determination as follows.

       1. Identify competency in a wide and international aspect which was accepted among various parties. However, operational conditions might be distinctive.

       2. Avoid identifying specifically clear competency in certain aspects, namely education degrees.

       3. Identify competency that was observable and measurable.

       4. What was distinguished was supposed to meet actual needs with supplementary examples explaining behaviors.

       5. Use literate language which was easy to comprehend when identifying competency.

       6. Write short, compact, and meaningful competency aspects.

       7. Separate competency aspects that looked similar clearly.

       8. Identify the future needs so as to train and get personnel ready in the future.

       9. Provide retrospective look for both performance and behavior so that they could be looked back upon between them.

       10.Identify the best behavior level of the practitioners clearly with examples of behaviors expected. It would be perfect if a normal level and the best level could be explained.

       11.Avoid competency regarding habits and personality as many of them could not be developed via training.

       12.Group similar competency together.

In conclusion, the competency element determination was the operational standard establishment emphasizing on knowledge, ability, skills, and good attitude in operation. This would be compared with existing personnel competency. In case, the personnel

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lacked any ability; the personnel themselves or their organization would develop what they still lacked as set in the standards as guidelines leading to the competency development based on McClelland's concepts of five parts as follows.

1. Knowledge alluded to a group of information as a rule of a factual or procedural nature expected to comprehend a certain subject.

2. Skills referred to the capacity to fulfill a certain mental task, for example analytical thinking and conceptual thinking or a physical assignment.

3. Self-concept referred to an individual's attitudes, values, and self-image, including self-identity and self-assurance.

4. Traits referred to physical and mental characteristics distinguished with the ways a person reliably reacted in a specific approaches to circumstances and messages.

5. Motives were steady considerations or longings that brought on a particular action. They incited practices toward specific activities or objectives and not toward others.

2.2.1.3 Types of competency

According to Narongwit Santhong (2004) and Jiraprapa Akkarabowon (2006), competency could be divided into five types as follows.

1. Organizational competencies: these alluded to core competencies of the organization that set the tone and connection in which the work of the organization was carried out.

2. Core competencies: these referred to capabilities or specialized aptitude one of a kind to an organization. An organizational core competency was an organization's strategic vital quality.

3. Functional competencies: they were job-specific competencies that drove demonstrated high-performance, quality results for a given position. They were regularly specialized or operational in nature.

4. Job competencies: they were individual potential identifying with the work in a unique position or role.

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5. Job competencies: they had a place with each person and were particular. No one could emulate from the individuals who had them.

2.2.1.4 Importance of competency

Suthat Nampoonsooksan (2002) stated that competency was important for the operation of personnel and organizations as follows.

1. Assist personnel selection so that the personnel possessing good qualification, knowledge, ability, and proper behaviors would be selected to work.

2. Enable practitioners to learn what level of their ability and what aspect needed to develop for the sake of their self-learning.

3. Apply into training and developing personnel in the organizations.

4. Support key performance indicators as competency could identify which aspects could help achieve the objectives of these indicators.

5. Convince the practitioners that performance was derived from their competency not from only fate.

6. Lead to better organizational competency as everyone could modify their competency to their organization performance regularly which resulted in possessing specific competency in a long run.

2.2.1.5 Competency application

Tien Tongkaew (2005) mentioned on applying competency into human resource management which could be performed variously as follows.

1. Human resource planning in both position needs regarding determination of competency for each position which was in accordance with organization strategy establishment

2. Job evaluation of wage and salary administration and compensable factors

3. Recruitment and selection which could be in according with the job position and competency

4. Job appointment was supposed to be considered from those whose competency and qualification matched with the positions required.

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5. Training and development was supposed to be in accordance with personnel competency ultimately.

6. Career planning and succession planning that an organization was supposed to prepare for their personnel in terms of steps, competency, organization assistance, and personnel self-development.

7. Rotation, termination, and promotion could be performed easily and properly on condition that the competency was acknowledge.

8. Performance management could rely on a quality management concept – a Quality Cycle PDCA – which could be utilized to plan human resource from a planning process on a basis of each individual competency, positioning right people based on their ability, and monitoring and evaluation.

2.2.1.6 Cautions and regulations in applying competency within an organization

Anon Sakwachirawit (2004: 64-72) mentioned on the cautions and regulations in applying competency within an organization as follows.

1. In determining competency, it was supposed to be done on a basis of theories, concepts, and reasons related to jobs. The causal relationship and performance results were supposed to be linked.

2. In applying competency, its validity had to be inspected via the empirical data, especially predictive validity that could separate those working very well from those working in average or those who did not work at all. If this could not be done, the concurrent validity measuring both competency and criteria variables could be measured.

3. Competency could not be measured if it was not determined previously. With validity and reliability, competency could be actually utilized in various processes of administrating human resource of the organizations.

4. In applying competency, it was supposed to be utilized completely within human resource management. It was about how to employ people of their ultimate benefits depending on their competency. They were supposed to be employed

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properly to their work so that each of them could exhibit and develop their competency existing ultimately.

5. In applying competency, the organizations had to establish competency development for each personnel clearly. This was supposed to begin from an aspect that could be developed easily. The organization had to have a career planning, a succession planning, difference analysis on competency of each individual, and the competency of each position. This could be in a form of individual development plan (IDP).

6. Competency would be beneficial if applied. However, validity identification could not be understood by some administrators. They did not want to know. Therefore, if competency was utilized actually, the money the organization earned had to be calculated.

7. The organizations were supposed to review competency so as to keep up with rapidly environmental, social, and technological change in order to examine validity whether it could separate those working very well from the others or not.

2.2.2 Teacher competency determination of educational personnel offices

2.2.2.1 Regulation on Professional Standards

In order to be in accordance with the National Education Act B.E 2542, the Teachers Council of Thailand Board issued the regulations on 12 teacher professional standards as detailed below (the Secretarial of the Teachers Council of Thailand: 2006)

Standard 1:
Regularly practice academic activities relating to development of the profession of teachers.
Standard 2:
Make decisions to practice various activities taking into account consequences on learners.
Standard 3:
Be committed to developing learners to reach their full potentiality.
Standard 4:

Develop teaching plans for effective implementation.

Standard 5:

Regularly develop instructional media to be effective.

Standard 6:

Organize instructional activities focusing on permanent results for learners.

Standard 7:

Systematically report on results of learners' quality development.

Standard 8:

Conduct themselves as a good role model for learners.

Standard 9:

Constructively cooperate with others in educational institution.

Standard 10:

Constructively cooperate with others in community.

Standard 11:

Seek and use information for development.

Standard 12:

Create opportunities for learners to learn under all circumstances.

2.2.2.2 Professional Ethics for Teachers

Professional Ethics referred to the ethical requirements regarding the conduct or the conduct of professional teachers. In order to maintain or enhance the reputation and prestige as a teacher, Thai Professional Ethics were provided in writing and supported by law for the first time in 1996. The Teachers' Council of Thailand announced Teachers Council of Thailand Regulations on Professional Ethics B.E. 2539 (A.D. 1996). There were nine Professional Ethics required for teachers.

1. Teachers needed to give students adoration and leniency. Take care, bolster and energize them equally.

2. Teachers needed to educate, train, and fortify students' knowledge, aptitudes and great propensities with full exertion and sincere.

3. Teachers needed to have good behaviors as a role model for students physically, verbally, and rationally.

4. Teachers did not need to act against the thriving of physical, scholarly, enthusiastic, mental and social strength of students.

5. Teachers did not need to exploit the remuneration of students in the performance of ordinary obligations and utilize students for personal exploitation.

6. Teachers needed to build up their professional, personality and vision to keep pace with the advancement of economic science, social and political life at all times.

7. Teachers needed to cherish and have confidence in the instructing profession. Be great members of the professional teacher organization.

8. Assist and support other teachers and community in a creative way.

9. Teachers were supposed to act as a leader in conservation and the development of wisdom and Thai culture.

It could be summarized that the professional ethics for teachers were considered operational guidelines for teachers so that they could maintain based on their professional principles and professional virtue resulting in shaping them to be ideal teachers and role models as expected by society. The professional ethics for teachers were important for teachers. These could also be employed to evaluate professional ethic competency and mathematics teacher competency.

2.2.2.3 Core competency based on the research of the teacher developing system of Ministry of Education

The educational offices and educators proposed teacher competency which the research collected and presented as follows. The Office of the Basic Education Commission stated that teacher competency consisted of (1) a command in using Thai for communication, (2) a command in utilizing English or foreign languages for knowledge pursuit, (3) a command of computer for learning, (4) curriculum construction and development, (5) a student-centered learning process management, (6) classroom management, (7) innovation development and application, (8) learning outcome evaluation, (9) classroom action research, (10) counselling and advising, (11) community cooperation construction, (12) a teacher leader, (13) maintaining virtue and morality in accordance with the professional ethics, and (14) self-analysis and development.

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2.2.2.4 Regulation of the Teachers Council of Thailand on Profession Standards

The Teachers Council of Thailand summarized four fundamental aspects of the teacher professional standards (the Secretarial of the Teachers Council of Thailand: 1999) which consisted of (1) being knowledgeable, (2) teaching well, (3) possessing virtue and ethics, and (4) aiming to develop.

2.2.2.5 Teacher competency as set in the Regulation on Professional Standards and Ethics

The Regulation of the Teachers Council of Thailand on Professional Standards and Ethics B.E. 2537 determined behavioral expression leading to achievement and student quality assurance consisting of 11 standards as follows (the Secretarial of the Teachers Council of Thailand: 1995, 10-21).

1. Regularly practice academic activities relating to development of the profession of teachers.

2. Make decisions to practice various activities taking into account consequences on learners.

3. Be committed to developing learners to reach their full potentiality.

4. Develop teaching plans for effective implementation

5. Regularly develop instructional media to be effective.

6. Organize instructional activities focusing on permanent results for learners.

7. Systematically report on results of learners' quality development.

8. Conduct themselves as a good role model for learners.

9. Constructively cooperate with others in educational institution.

10. Constructively cooperate with others in community.

11. Seek and use information for development.

2.2.2.6 Standard of Professional Knowledge and Experience (The Teachers' Council of Thailand: 2005)

Those who practiced the profession of teachers had to meet the standards of professional knowledge and experience as follows.

1. Standards of knowledge: have minimum qualifications with Bachelor's degree in education or the equivalent or other degrees as accredited by the Teachers Council of Thailand, with the knowledge in the following areas.

      1.1 Language and technology for teachers
      1.2 Curriculum development
      1.3 Learning management
      1.4 Psychology for teachers
      1.5 Educational measurement and evaluation
      1.6 Classroom management
      1.7 Educational research
      1.8 Educational innovation and information technology
      1.9 Teachership

2. Standards of professional experience: have completed the practical training in educational institutions under the educational degree curriculum for a minimum of one year and passed the criteria for evaluation of the practical training in accordance with the rules, procedures and conditions as set out by the Teachers Council of Thailand Board as follows.

      2.1 Training on professional practice during study
      2.2 Practical training in educational institutions on specific subjects

3. Standards of performance

Those who practiced the profession of teachers had to perform their duties in accordance with the standards of performance as follows.

      3.1 Regularly practice academic activities relating to development of the profession of teachers.

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3.2 Make decisions to practice various activities taking into account consequences on learners.

3.3 Be committed to developing learners to reach their full potentiality.

3.4 Develop teaching plans for effective implementation

3.5 Regularly develop instructional media to be effective.

3.6 Organize instructional activities focusing on permanent results for learners.

3.7 Systematically report on results of learners' quality development.

3.8 Conduct themselves as a good role model for learners.

3.9 Constructively cooperate with others in educational institution.

3.10 Constructively cooperate with others in community.

3.11 Seek and use information for development.

3.12 Create opportunities for learners to learn under all circumstances.

2.2.2.7 Code of Ethics of the Education Profession

Proficient teachers were required to conduct themselves in accordance with the Code of Ethics of the Education Profession B.E. 2556 as follows (the Office of the Education Council: 1996).

Commitment to self-discipline:

Proficient teachers needed to possess self-discipline and enhance their professional practice, personality and vision to stay aware of the scholastic, economic, social and political development.

Commitment to the profession:

Proficient teachers had to have love, confidence, respectability, and obligation regarding the profession and act as great members of a professional organization.

Commitment to clients:

1. Professional teachers needed to watch over, be tolerant to, pay consideration on, assist and encourage their students and clients equally, in accordance with their roles and obligations.

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2. Professional teachers had to encourage their student and clients to accomplish learning, aptitudes and good behavior, in accordance with their roles and obligtions to their full capability and liberality.

3. Professional instructors had to conduct themselves as great role models in terms of physical behavior, discourse, and mental behavior.

4. Professional instructors did not have to act in any manner which was against the physical, scholarly, mental, enthusiastic, or social development of their students and clients.

5. Professional instructors had to give benefit sincerely and equally without requesting, tolerating or procuring any intrigues which would be considered abuses of their authority.

Commitment to colleague:

Professional instructors had to provide assistance and backing to one another constructively, behave ethically, and make cooperative among themselves.

Commitment to society:

Professional instructors had to conduct themselves as leaders in economic, social, religious, masterful, cultural, intellectual, and environmental conservation and development as well as preserve public interests by holding to the democratic government with the King as Head of State.

In conclusion, the professional standards for teachers consisted of the standards of knowledge, the standards of professional experience, the standards of performance, and the standards of conduct. Likewise, the profession ethics for teachers were the regulation that teachers could behave themselves as determined.

2.2.2.8 Competency as set in the educational standards for external quality assessment (regarding teachers)

The educational standards for external quality assessment of the basic education regarding teacher quality were distinguished in two factor standards as follows (the Office for National Education Standards and Quality Assessment (2009: 6).

Standard 8:

Teachers possessed qualifications, knowledge, and ability matched with their responsibilities and numbers.

Indicators:

1. Teachers possessed proper characteristics.

2. Teachers held minimum qualifications with Bachelor's degree in education or the equivalent.

3. Teachers taught in the subject with graduated majors/minors or skills.

4. Teachers were developed in their subjects as set by the Teachers Council of Thailand.

5. Educational institutions possessed the number of teachers as set by the Office of the Teacher Civil Service and Educational Personnel Commission.

Standard 9:

Teachers possessed ability in teaching and learning management efficiently on a basis of a student-centered aspect.

Indicators:

1. Teachers possessed knowledge and understanding in the objectives of the basic education management.

2. Teachers possessed knowledge and ability in providing learning experience on a student-centered aspect.

3. Teachers could evaluate student development completely and properly in all aspects in accordance with actual conditions of learning.

4. Teachers could apply student development evaluation results to modify experience management in order to develop student potential ultimately.

In conclusion, there were two educational standards for external quality assessment of the basic education regarding teachers which were as follows. (1) Teachers possessed ability in teaching and learning management efficiently on a basis of a student-centered aspect, and (2) teachers possessed knowledge and understanding matched with their responsibilities.

2.2.2.9 Teacher competency in Thailand

Many scholars and offices determined teacher competency variously as detailed below.

Sirichai Kanjanawasee (2003) determined teacher competency by analyzing job descriptions and job position analysis covering primary missions of teachers in teaching and learning management, student enhancement and development, academic operation of educational institutions, and construction of community relationship and cooperation. Each primary mission consisted of knowledge, skill, and personal characteristics as detailed below.

Primary missions regarding teaching and learning management consisted of seven key competency aspects as follows.

      1. General knowledge in educational concepts (knowledge)

      2. Specific knowledge in teaching fields (knowledge)

      3. Knowledge in educational research concepts (knowledge)

      4. Communication skills (skills)

      5. Learning activity management (skills)

      6. Teachership developed from teaching and learning management (personality)

      7. Teachership developed from profession (personality)

Primary missions regarding enhancing and developing students consisted of three key competency aspects as follows.

      1. Knowledge in student enhancement and development concepts (knowledge)

      2. Thinking and problem-solving skills (skills)

      3. Acceptance from students (personality)

Primary missions regarding the academic operation of educational institutions consisted of three key competency aspects as follows.

      1. Knowledge in the academic work of the educational institutions (knowledge)

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2. Skills in operating the academic work of the educational institutions (skills)

3. Academic acceptance (personality)

Primary missions regarding the construction of community relationship and cooperation consisted of three key competency aspects as follows.

1. Knowledge in cooperation and relationship construction concepts (knowledge)

2. Skills in constructing relationship and cooperation (skills)

3. Acceptance from guardians and community (personality)

Jaithip Na-songkla (2004) mentioned about the teacher competency in an electronic learning era by analyzing a model scheme of the national education communication technology of Thailand. The details of teacher competency, knowledge, and ability in terms of technology were as follows.

1. Teachers had to possess knowledge of technology widely enough to direct students.

2. Teachers had to use computers as a tool in searching for data sources, teaching preparation and homework, communication with students, guardians, and other teachers, and general affair jobs.

3. Teachers had to be able to integrate technology and information technology with classroom activities in order to create learning atmosphere that supported analytical and creative thoughts of students. However, teachers needed to develop and adjust themselves in technological advancement constantly.

2.2.3 Mathematics teacher competency concepts

2.2.3.1 Mathematics teacher competency prior to graduation

According to the announcement of Ministry of Education on Thai Qualifications Framework for Higher Education (TQF: 2009), the field qualification standards were determined in order for the higher educational institutions to prepare their curriculum and manage teaching and learning so that graduate quality regarding Bachelor's degree

in education (a five-year curriculum). This was announced in 2011 with details as summarized below (the Office of the Higher Education Commission: 2013).

    1. Specific knowledge domain (teacher profession)

      1.1 Virtue and morality

        1.1.1 Teacher virtue and morality

        1.1.2 Teacher professional ethics determined by the Teachers Council of Thailand

      1.2 Knowledge

        Integration of knowledge regarding education and teacher profession which included at least the following items

        1.2.1 Pedagogical knowledge

Education concepts and philosophy, teacher profession, and teachership

Development psychology

Curriculum design and development

Learning design and management

Classroom management and learning environment

Information technology and communication for teachers

Educational innovation construction

Educational measurement and evaluation

Special education

Educational research

Educational administration and relevant legislation

        1.2.2 Integrative knowledge between teacher profession and specific content (pedagogical-content knowledge)

Teacher psychology for learning management in each level and major

Curriculum development for each level and major

Learning management for each level and major

Classroom management for each level and major

Innovation and information technology for each level and major

Educational measurement and evaluation for each level and major

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1.3 Cognitive skills

1.3.1 Apply mathematics knowledge and understanding of concepts, principles, theories, and procedures into learning management.

1.3.2 Analyze situations and apply conceptual understanding of mathematics principles and theories in critical thinking and creative problem-solving when faced with unanticipated new situations.

1.4 Interpersonal skills and responsibility

1.4.1 Perceive feelings of the students.

1.4.2 Pay attention to listen to the students.

1.4.3 Develop interpersonal relationship responsibility.

1.5 Analytical and communication skills

Be rapid in analyzing and summarizing mathematics news from students in primary and secondary levels. Be able to communicate. Be able to consider and select information technology presentation for mathematics students in the primary and secondary levels properly.

1.6 Learning management skills

1.6.1 Expertise in managing mathematics learning in various forms both formal and non-formal, and informal creatively.

1.6.2 Expertise in managing mathematics learning in various forms among students having special ability, moderate ability, and innovatively special ability.

1.6.3 Expertise in managing mathematics integrative learning.

In conclusion, mathematics teacher competency prior to graduation based on the qualification of Bachelor's degree in education (a five-year curriculum) covered in an overall aspect, namely virtue, morality, knowledge, problem-solving skills, interpersonal relationship, and number skills. The major in mathematics was a competency aiming to possess professional expertise and manage teaching and learning properly and in harmony with nature of students. Therefore, it could lead to professional expertise in accordance with that of the Teachers Council of Thailand, The Institute for the Promotion of Teaching Science and Technology, and teacher profession ethics.

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2.2.3.2 Definitions of mathematics teachers

According to an educational dictionary of Good (cited in Lorpong Upapong: 2001, 14), teachers were defined as follows.

1. Teachers were individuals that were hired by government in order for them to advice and prepare learning experience for students or university students in educational institutions of the State or the private sectors.

2. Teachers were individuals possessing experience, good education, or both in a particular field enabling them to grow and develop onward.

3. Teachers were individuals who taught and train others.

It could be concluded that mathematics teachers were teachers who possessed mathematics content and knowledge well. They could deliver mathematics knowledge in various methods, provide experience in learning mathematics to students in order for them to know how to think and solve problems, grow virtue and morality among students to be guidelines for their lives, be a desirable individual for society, and be ready both physically and mentally.

2.2.3.3 Characteristics of mathematics teachers

Many educators proposed the mathematics teacher characteristics as follows.

Yon Chumjit (1987) mentioned the characteristics of mathematics teachers as follows.

1. Good personality both physical and mental, such as good appearance, dignified look, neat dressing, soft and kind speaking, leadership, and clear voice, etc.

2. Good personal characteristics, such as well intellectual, intelligent, widely knowledgeable, creative, active, and healthy, etc.

3. Ability in teaching and governing classrooms

4. Good behavior

5. Teacher ethics and high virtue

6. Good interpersonal relationship that was friendly to all parties

Chaweewan Keeratikorn (2004) stated mathematics teacher characteristics as follows.

1. Possess good knowledge: they possessed knowledge in what they taught thoroughly. Comprehend reasoning and know the knowledge sources.

2. Pay attention to their teaching with love toward mathematics they taught. They were supposed to enjoy the content and activities of what they taught.

3. Possess virtue and empowerment so that students would be positively empowered. This could be done by giving praise.

Wilawan Chotibenjamaporn (2000: 69) mentioned that good teachers in an education reform era were supposed to characterize as follows.

1. Good qualification: this included good qualification and characteristics, such as knowledge, ability, personality, health, qualification, habits, visions, values, and self-virtue.

2. Good behaviors: this included being a good citizen behaving in accordance with teacher ethics.

3. Good performance: this referred to good planning, teaching, counselling, learning activity management, governing, evaluating, good intention in conducting every task, and being friendly to all students.

4. Good works: this included when students possessed learning and intelligence, knew how to think critically, were well-disciplined and happy, and had the capacity in depending on themselves.

5. Good benefits: this happened when teachers gained incentives in the forms of benefits and professional advancement.

6. Good dignity: this included when teachers were praised and honored from their colleagues, communities, and societies in that they were valuable.

As for mathematics teachers, they were supposed to have the capacity as follows.

1. Possess knowledge and experience in learning management, knowledge development, and experience construction so as to allow students to comprehend and authentically practice. They were supposed to acknowledge content consistency and connect the content within the same science and others.

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2. Possess knowledge and understanding regarding the importance, nature, and specific characteristics of mathematics. They were supposed to provide learning content in terms of learning, skills/processes, virtue, morality, and values as stated in the curriculum. They could provide learning activities, develop learning media, and measure and evaluate learning outcomes as stated in the learning standards.

3. Behave as those seeking for knowledge, adjusting, and developing themselves so as to keep up with new innovation and possess creativity.

4. Recognize nature and student needs. They were supposed to allow students to participate in learning and practices.

5. Possess ability in providing numerous learning activities with appropriate utilization of technological media as well as constructing atmosphere that facilitated learning (Ministry of Education: 2001, 186-187).

2.2.3.4 Mathematics teacher standards

The Institute for the Promotion of Teaching Science and Technology (2002: 19-56) distinguished the competency of mathematics teachers through the arrangement of the standards for mathematics teachers that the mathematics teachers had guidelines to develop themselves and improve into international standards. Schools were encouraged to use the guidelines to develop their mathematics teachers to have knowledge and capacities according the distinguished standards, which contained 10 standards as the followings.

Standard 1 was distinguished with comprehension the nature of mathematics, which was made out of the content structure of the curriculum, the learning contents of mathematics subjects, and the concepts about problem-solving.

Standard 2 was distinguished with the instructors' applying mathematics into utilization with morality and human interests in developing their own professions. The application of mathematics with morality would collect benefits to the society and the public life through considering their public safety as the instructors sought for the opportunities to develop their own good career.

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Standard 3 was distinguished with the arrangement of the learning opportunities according to the learning levels and the advancement of the students, as well as the comprehension of the learning levels and the development of the students, and the arrangement of the opportunities to build up their own career in the future.

Standard 4 was distinguished with the arrangement of the learning procedure according to the distinctions among the students. Understanding these distinctions and utilizing such contrasts as the bases in the learning procedure arrangement were helpful to develop the learning opportunities consistently to the students' necessities.

Standard 5 specified the utilization of appropriate instructing methods to enhance the learning improvement of the students, and the utilization of distinctive teaching methods to elevate the students to build up the analytical thinking, critical thinking and problem solving and plan implementation aptitudes.

Standard 6 was distinguished with the creation of inspiration after which the students picked up inspiration, comprehended the motivation and behavior of the students or gatherings of students, and created the learning environment that elevated positive collaboration to create inspirational learning.

Standard 7 mentioned about developing the communication skills to improve the learning through knowledge, communication skills and correct language utilization including speaking, writing, communicating thoughts, utilizing communication methods, discovering knowledge, collaborating, and working together.

Standard 8 was related to the curriculum development, learning contents, and teaching plan preparation, which all depended on the basic of the contents and the learning standards consistent with the needs of the communities and the improvement of the students' to their full potentials.

Standard 9 was about the assessment to develop the learning. The application of the evaluation methods depended on the facts or the genuine situation and the assessment to affirm the learning development of the students consistently in terms of physical, social relations, intelligence, and wisdom.

Standard 10 was about involving the communities to orchestrate the education and the learning development for the students to advance the relationships among the participants in the educational institution, i.e., schools, parents, and community organizations to construct supports for the learning development of the students.

In conclusion, the ten mathematics teacher standards were the criteria utilized to measure mathematics teacher education management. This could facilitate teaching and learning management so that the operation would be efficient with full potential in developing students to possess knowledge, thoughts, skills, learning procedures, attitude, virtue, morality, and desirable attributes as set in the standards. Therefore, the construction of an evaluation model of mathematics teacher competency could be utilized to supplement mathematics teacher competency evaluation in terms of necessary competency toward teaching and learning management.

2.3 Concepts of Evaluation, Evaluation Model Development, Development of Elements and Indicators, and Personnel Evaluation

2.3.1 Evaluation

2.3.1.1 Definition of evaluation

Many scholars on evaluation defined evaluation. Mehrens and Lehmann (1978) stated that evaluation was planning, collecting, and applying useful data for making a decision. Ebel and Frisbie (1986) mentioned that evaluation was a decision regarding quality or value of what needed to be evaluated. This was in accordance with that of Sax (1987) who defined evaluation as a process of making a decision on values gained from observation, experience, and training of assessors. Uthumporn Jamornman (1987) stated that an evaluation referred to the judgment on values of what was measured on a basis of internal and external criteria. Additionally, Tai Siengchi (2010) defined an evaluation that it was a systematic search on what was authentic or existed in projects by comparing with standardized criteria in order to judge whether that could achieve objectives or not, or whether that was supposed to change, continue, or abolish or not. Pichit Ritjaroon (2005) also mentioned that an evaluation was a judgment of values or quality of the results measured by comparing with other measurement or with the set

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criteria. Besides, Sirichai Kanchanawasee (2009) defined an evaluation that it was a judgment on values of numerous aspects based on standardized criteria.

According to the aforementioned opinions of those educators, it could be concluded that an evaluation was a judgment on values of numerous aspects by comparing collected information data or the results of measurement with the criteria so as to gain reliable information for adopting in decision making.

2.3.1.2 Evaluation importance

An evaluation was important and beneficial toward those relevant, especially education. Numerous scholars mentioned the importance of educational evaluation as follows.

Worthen and Standers (1973) mentioned the importance of educational evaluation in terms of its important role as follows.

    1. To be information supporting decision making;

    2. To evaluate learning accomplishment;

    3. To evaluate curriculum;

    4. To accredit educational institutions; and

    5. To modify educational equipment and materials.

Somboon Tanya (2002) mentioned the importance of the educational evaluation as summarized below.

    1. Indicate whether the operational objectives were appropriate and possible or not in what scale.

    2. Acknowledge whether the operation achieved the objectives or not.

    3. Motivate an urge in modifying and operating.

    4. Assist in recognizing operational drawbacks found in each step. This was a foundation to modify the operation.

    5. Control the operation so that it maintained quality and efficiency which could help decrease resource wastes.

    6. Provide information for administrators in their operation.

    7. Act as guidelines in determining appropriate methods for further operation.

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2.3.1.3 Development of evaluation models

Due to the fact that models contained different types, the construction or development of the models depended on the judgment of model appropriateness. The models selected might be considered from analyzing an accordance between philosophy or concepts of an evaluation model and problematic issues of what needed to be evaluated (Sirichai Kanchanawasee: 2002, 127-128). Certain scholars proposed the concepts regarding the development of an evaluation model as follows.

Nevo (1983: 117-128) proposed the concepts in constructing and developing evaluation models by revising Stufflebeam's list of questions and extending it to ten major dimensions representing the major issues addressed by the most prominent evaluation approaches in education as detailed below.

1. The definition of evaluation: the educational evaluation was characterized as a systematic activity of utilizing information to depict educational objects and judge their legitimacy or worth. This definition incorporated the two most critical characteristics of evaluation which were description and judgment.

2. Functions of evaluation: evaluation could serve two functions, the formative and the summative. In its formative function, evaluation was utilized for the improvement and advancement of a continuous movement. In its summative function, evaluation was utilized for responsibility, affirmation, or selection. A third function of evaluation, the psychological or socio-political function was supposed to be considered

3. Evaluation objects: students and instructors were constantly mainstream objects of evaluation in education. Almost all the measurement and evaluation literature in education managed the evaluation of students' learning. Up to that time, one could scarcely discover in the educational literature any significant direction regarding the evaluation of other objects, for example educational projects or programs, curricular materials, or educational institutions. Distinctive development in the educational framework prompted a critical movement of center in regards to the objects of educational evaluation from students to projects, programs, and instructional materials.

4. Evaluative information: after an evaluation object was chosen, a decision had to be made in regards to the distinctive viewpoints and dimensions of the object that was supposed to be evaluated. Information applicable to such viewpoints had to be gathered. Prior ways to deal with evaluation concentrated for the most part on results or outcomes. In this way, to evaluate an educational object, for instance a new curriculum, would intend to evaluate the quality of the results of its functioning, for instance students' accomplishments. In recent years, some intriguing attempts were made to develop the scope of evaluation variables was distinctive evaluation models.

5. Evaluation criteria: to choose criteria by which to judge the value of an evaluation object was one of the most troublesome tasks in educational evaluation. The individuals who suspected that evaluation was supposed to endeavor to figure out whether objectives were accomplished made this task simple for themselves by partially overlooking the issue of evaluation criteria. What they actually did was use objective accomplishment as the evaluation criterion without having legitimated its being an appropriate foundation.

6. Clients and audiences of evaluation: the individuals who characterized evaluation as providing information for decision making appeared to have a reasonable opinion with reference to who had to be served by the evaluation. They distinguished the applicable decision makers and endeavored to determine their information needs.

7. The evaluation process: the procedure of doing an evaluation was a function of the theoretical recognition that guided the evaluation. A theoretical approach that perceived evaluation as a movement proposed to figure out whether objectives were accomplished might bring about the accompanying evaluation process. To start with, objectives were expressed in behavioral terms. Next, measurement instruments were produced. Next, information were gathered. Next, finding were interpreted. And, finally, recommendations were made.

8. Methods of inquiry: distinctive new methods of inquiry were introduced into the field of educational evaluation. Notwithstanding traditional experimental and quasi-experimental designs, distinctive routines got to be authentic for the conduct of evaluation. Among them were naturalistic systems, jury trials, contextual

investigations, art criticism, journalistic techniques, and the usual way of doing things strategy. Moreover, the facts might confirm that for a convoluted task, for example the conduct of evaluation, an approach was required that sought the best method or set of methods for noting a specific evaluation question, as opposed to expecting that one method was best for all reasons.

9. Types of evaluators: since turning into a professional group, evaluators dedicated a lot of their thoughtfulness regarding distinguishing the characteristics of good evaluators and fitting approaches to train them. To be a capable and trustworthy evaluator, one needed to have a combination of a wide variety of characteristics. These included technical competence in the range of measurement and research methods, comprehension of the social setting and the substance of the evaluation object, human relations abilities, personal honesty and objectivity, and additionally characteristics distinguished with their authority and responsibility within their organizations. Because it was difficult to find one individual possessing all these qualifications, it frequently became necessary to have a group of evaluators direct an evaluation or then again to choose a person with the most appropriate attributes for a particular evaluation task.

10. Evaluation standards: the most expand and far reaching set, and the one taking into account the largest amount of agreement, was probably the set developed and distributed by the Joint Committee on Standards for Educational Evaluation (1981). The committee proposed 30 standards which were partitioned into four major groups which were (1) utility standards to guarantee that evaluation served practical information needs, (2) feasibility standards to guarantee that evaluation was sensible and reasonable, (3) propriety standards to guarantee that evaluation was conducted legally and morally, and (4) accuracy standards to guarantee that evaluation uncovered and passed on technically sufficient information.

2.3.1.4 Steps of developing models

Borg and Gall (1983) mentioned that there were ten main steps in conducting research and development process which were as follows.

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Step 1 involved research and information collecting or need analysis. It included review of literature, classroom observations, and preparation of reports.

Step 2 consisted of planning. It included defining skills, stating objectives, determining course sequence, and small scale feasibility testing.

Step 3 consisted of develop preliminary form of product. It included preparation of instructional materials.

Step 4 involved preliminary field testing. It included interview, questionnaire data collected, and analyzed from the school.

Step 5 involved main product revision. It utilized quantitative data on subjects' course as evaluation.

Step 6 consisted of main field testing.

Step 7 consisted of operational product revision as suggested by main field-test results.

Step 8 involved operational field testing.

Step 9 involved final product revision.

Step 10 involved dissemination and implementation.

Pethburi Rajabhat Institution (2002: 40) researched on a model of teacher development in teaching and learning management which consisted of six operational steps as follows.

1. Study concepts regarding model development.
2. Construct the model.
3. Examine the model by connoisseurs.
4. Try out the model in an experimental school and firstly modify it.
5. Try out the model in an experimental school and secondly modify it.
6. Examine the school performance by the connoisseurs and modify it.

Waree Kaewurai, Tieumjan Panitplinchai, and Chada Klinchareon (2004: 43) researched on developing a reform model of learning processes which consisted of three steps which were as follows.

1. Study documents and relevant research, conduct fieldwork, and synthesize a model.

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2. Examine the model quality developed by connoisseurs.

3. Examine its validity by a method of confirmatory factor analysis with model teachers and leader teachers reforming learning in various fields.

Chalongrat Insee (2007: 49) conducted the research on a model development which consisted of three steps which were as follows.

1. Study documents and relevant research.

2. Develop a model by drafting, proposing to connoisseurs for their consideration on propriety, feasibility, and accordance with an action plan, and modifying the model.

3. Try out the model and study the model application results.

According to the aforementioned concepts, the key steps of model development consisted of constructing or developing the model based on the concepts, theories, and relevant research. After that, the model structures were combined. The model validity was examined in order to inspect the model propriety. And, the evaluation of model application in an overall aspect was summarized. As for the research on an evaluation model of mathematics teacher competency in the lower secondary schools, the researcher applied the steps of factor analysis, model synthesis, model design, model examination, model modification, model try-out, and the evaluation of model efficiency by considering the model evaluation which was harmonious and covered inputs, processes, outputs, and feedback.

2.3.1.5 Model evaluation

Stufflebeam (1981, cited in Sirichai Kanchanawasee: 2007), Chair of the Joint Committee on Guidelines and Standards for Educational Evaluation, and evaluation connoisseurs believed that an evaluation was necessary for human activities. Good evaluation could enhance understanding and develop to what was better. On the contrary, bad evaluation would hinder and destroy the advancement. The committee then proposed 30 criteria which would be utilized as standards in evaluation activities. They could be classified into four parts as follows.

A: Utility Standards

The utility standards were expected to guarantee that an evaluation would serve the practical information needs of proposed users. These standards were as follows.

      A1 Stakeholder identification

      A2 Evaluator credibility

      A3 Information scope and selection

      A4 Values identification

      A5 Report clarity

      A6 Report dissemination

      A7 Report timeliness

      A8 Evaluation impact

B: Feasibility Standards

The feasibility standards were expected to guarantee that an evaluation would be practical, reasonable, conciliatory, and thrifty. The standards were as follows.

      B1 Practical procedures

      B2 Political viability

      B3 Cost effectiveness

C: Propriety Standards

The propriety standards were expected to guarantee that an evaluation would be conducted legitimately, morally, and with due respect for the welfare of those included in the evaluation, and additionally those influenced by its outcomes. These standards were as follows.

      C1 Formal obligation

      C2 Conflict interest

      C3 Full and frank disclosure

      C4 Public's right to know

      C5 Rights of human subjects

      C6 Human interactions

      C7 Balanced reporting

C8 Fiscal responsibility

D: Accuracy Standards

The accuracy standards were expected to guarantee that an evaluation would uncover and pass on technically adequate information about the components that determined worth or value of the program being evaluation. The standards were as follows.

D1 Object identification

D2 Context analysis

D3 Described purposes and procedures

D4 Defensible information sources

D5 Valid measurement

D6 Reliable measurement

D7 Systematic data control

D8 Analysis of quantitative information

D9 Analysis of qualitative information

D10 Justified conclusions

D11 Objective reporting

The standards utilized to evaluate programs or developed models as guidelines in determining the quality of the programs or models relevant to education were developed by the Joint Committee of Standards for Educational Evaluation which was accredited by the American National Standards Institute. The standards were classified into four aspects as follows (Sirichai Kanchanawasi: 2007).

1. Utility standards were proposed to guarantee that an evaluation will serve the information needs of planned users. The utility standards for program evaluation fused the following.

1.1 U1: Stakeholder Identification: the people included in the evaluation and the individuals who would be influenced by the evaluation had to be distinguished so that their needs could be tended to.

1.2 U2: Evaluator Credibility: the people leading the evaluation had to be reliable and skilled to perform the evaluation in order for the evaluation's discoveries to accomplish most extreme believability and acknowledgement.

1.3 U3: Information Scope and Selection: the gathered information had to be extensively chosen with the goal that it tended to relevant inquiries concerning the program and was able to be receptive to the needs and interests of clients and other indicated stakeholders.

1.4 U4: Values Identification: the points of view, procedures and basis utilized to interpret the findings of the evaluation were supposed to be precisely portrayed so that the bases for value judgments were clear.

1.5 U5: Report Clarity: an evaluation report had to absolutely portray the program being evaluated, including its connection, purposes, procedures and findings so that the fundamental information was provided and straightforward.

1.6 U6: Report Timelines and Dissemination: evaluation reports and any huge between time findings were supposed to be dispersed to planned users so that they might be utilized in a timely fashion.

1.7 U7: Evaluation Impact: the way an evaluation was arranged, conducted and reported was supposed to encourage complete by stakeholders in order to increase the probability that the evaluation will be utilized.

2. Feasibility standards were proposed to guarantee that an evaluation would be practical, reasonable, political, and economical. The feasibility standards for program evaluation fused the following.

2.1 F1: Practical Procedures: evaluation procedures were supposed to be down to earth in order to keep interruption to a base while significant and required information was obtained.

2.2 F2: Political Viability: whilst arranging and directing the evaluation one had to foresee the diverse positions of distinctive interest groups so that their co-operation might be acquired. This would likewise permit one to deflect or neutralize any conceivable endeavors by these groups to obstruct evaluation operations or to predisposition or twist the evaluation's results.

2.3 F3: Cost Effectiveness: a great evaluation was supposed to be proficient and produce information of sufficient value to legitimize the utilization of accessible resources.

3. Propriety standards were expected to guarantee that an evaluation would be conducted lawfully, ethically, and with due respect for the welfare of those included in the evaluation, as well as those influenced by its results. These standards were as follows.

3.1 P1: Service Orientation: evaluations were supposed to be intended to assist organizations to address and adequately serve the needs of the full range of focused participants.

3.2 P2: Formal Agreements: commitments of the formal parties to an evaluation (what was to be done, how, by whom, when) were to be consented to in composing, so that these parties were committed to hold fast to all conditions of the agreement or formally to renegotiate it.

3.3 P3: Rights of Human Subjects: evaluations were supposed to be outlined and directed to respect and secure the rights and welfare of human subjects.

3.4 P4: Human Interactions: evaluators were supposed to regard human nobility and worth in their cooperation with distinctive persons connected with an evaluation, so that participants were not debilitated or harmed.

3.5 P5: Complete and Fair Assessment: the evaluation was supposed to be finished and reasonable in its examination and recording of strengths and weaknesses of the program being evaluated, so that strengths could be based upon and problem areas tended to.

3.6 P6: Disclosure of Findings: the formal parties to an evaluation were supposed to guarantee that the full arrangement of evaluation findings along with correlated confinements were made accessible to the persons influenced by the evaluation, and any others with communicated lawful rights to receive the results.

3.7 P7: Conflict of Interest: conflict of interest was supposed to be managed transparently and truly, so that it did not trade off the evaluation processes and results.

3.8 P8: Fiscal Responsibility: the evaluator's allocation and expenditure of resources were supposed to reflect sound accountability methods and generally be judicious and morally mindful, so that expenditures were represented and proper.

4. Accuracy standards were planned to guarantee that an evaluation would uncover and pass on technically sufficient information about the elements that

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determine worth or value of the program being evaluated. The standards were as follows.

4.1 Al: Program Documentation: the program being evaluated was supposed to be portrayed and archived obviously and precisely, so that the program was unmistakably distinguished.

4.2 A2: Context Analysis: the context in which the program existed was supposed to be analyzed in enough detail, so that its feasible influences on the program could be distinguished.

4.3 A3: Described Purposes and Procedures: the purposes and methodology of the evaluation were supposed to be monitored and portrayed in enough detail, so that they could be distinguished and surveyed.

4.4 A4: Defensible Information Sources: the sources of information utilized in a program evaluation were supposed to be portrayed in enough detail, so that the sufficiency of the information could be surveyed.

4.5 A5: Valid Information: the information gathering procedures were supposed to be chosen or developed and after that actualized so that they would guarantee that the elucidation landed at was legitimate for the planned utilization.

4.6 A6: Reliable Information: the information gathering procedures were supposed to be chosen or developed and after that actualized so that they would guarantee that the information obtained was adequately solid for the proposed utilization.

4.7 A7: Systematic Information: the information gathered, handled, and reported in an evaluation was supposed to be efficiently checked on and any errors observed were supposed to be adjusted.

4.8 A8: Analysis of Quantitative Information: quantitative information in an evaluation was supposed to be appropriately and efficiently examined so that evaluation inquiries were successfully replied.

4.9 A9: Analysis of Qualitative Information: qualitative information in an evaluation was supposed to be appropriately and efficiently examined so that evaluation inquiries were adequately replied.

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4.10 A10: Justified Conclusions: the conclusions came to in an evaluation were supposed to be unequivocally advocated, so that stakeholders could evaluate them.

4.11 All: Impartial Reporting: reporting procedures were supposed to prepare for contortion brought on by individual feelings and inclinations of any party to the evaluation, so that evaluation reports genuinely mirrored the evaluation findings.

4.12 A12: Meta-evaluation: the evaluation itself was supposed to be developmentally and contentiously evaluated against these and other related standards, so that its conduct was fittingly guided and, on finishing, stakeholders could intently analyze its strengths and weaknesses.

2.3.2 Development of elements and indicators

2.3.2.1 Indicators

Indicators meant variables or components that had values to reveal the quality or quantity of the implementation system in certain part in certain time. It was the information that could tell the situation in certain qualification when the variables or the facts could be correlated to each other. This correlation would create values that could reflect the holistic situation under study. The five qualifications of indicators according to Johnstone (1981) were given below.

1. Indicators could give information about things or conditions under study. Indicators that were utilized in social science might provide exactness about the information, but it was redundant that they would be correct and precise.

2. Indicators were not the same as variables. Indicators might be delivered from combination of numerous variables together that were related to one another together to demonstrate the entire picture of things or conditions under study. But variables gave information on things or conditions under study in barely one aspect in light of the fact that it had unique qualification, e.g. proportion of teachers against students.

3. Indicators had to distinguish quantity. Indicators had to demonstrate the conditions in figures for quantification. In coordinating the implications or estimations of indicators, they had to be compared with pre-recognized criteria. Therefore, the

building of indicators had to utilize distinguishing the definitions and criteria of indicators obviously.

4. Indicators would have impermanent values. Indicators had values at certain or brief period of time. At the point when time changed, the values of indicators could likewise change.

5. Indicator was the essential unit for development of speculations. Indicators implied variables or components that had values to uncover the quality or quantity of the implementation system in certain part in certain time. It was the information that could tell the situation in certain qualification when the variables or the certainties could be connected to each other. This connection would create values that could mirror the comprehensive situation under study.

2.3.2.2 The process of indicator development

The researcher studied the construction procedure in constructing and developing indicators which Johnstone (1981: 33) proposed regarding the indicator development. There were various methods in developing, but there were four aspects that any developer had to consider as follows.

1. Determine or define indicators
2. Select variables utilized to construct indicators
3. Combine variables into proper indicators
4. Determine weight for each variable that would be combined as indicators

Nongluck Wiratchai (1998: 20-29) summarized six steps procedural operation in developing indicators as follows.

Step 1: Statement of Purposes

The principal stride to develop indicators was expressing purposes to develop indicators. The researcher had to distinguish in advance what was the utilization for developed indicators, on what topics, and how.

Step 2: Definition of Indicators

After identification of objectives for developing indicators, the important thing in developing indicators was to distinguish the definition of the developed indicators. The

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definition of distinguished indicator would lead to the methods utilized for the next step of the process for developing indicators. In the step of making definition of indicators, it was to distinguish not only definition but also an individual indicator, i.e. what sub-variables it was composed of and how combination of sub-variables resembled. The definitions of indicators were divided into two parts as follows.

1. Conceptualization: the conceptualization part of definition was giving definition of qualification of the things that needed to indicate in form of model or a conceptual model of the things that needed to demonstrate. How many dimensions the sub-component had, what concepts each dimension comprised of, and what concept each dimension was composed of?

2. Constructing and scaling: this definition distinguished definition of sub-variables taking into account the conceptual model and recognized the method to combine sub-variables into indicators. Identification of definition of indicators was composed of three steps of identification as follows.

2.1 Identify components or sub-variables (components variables) of indicators. The researcher depended on knowledge theory and experience in studying component variables that were connected and significant to indicators and made decision to select component variables that how many component variables needed and what type utilized in developing indicators.

2.2 Identify combination method and component variables. The researcher studied and made decision to select the total combining method for component variables to get a developed set of indicators. Generally, it could be done in two ways as follows.

2.2.1 Additive combination: this method was based on the concepts that each variable could compensate or replace with another variable with any change in the common indicator value. For example, if a component variable value V_1 was low, but V_2 was high, the value of V_1 could be compensated by V_2. This resulted in no change in a common indicator value.

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$$I \quad = \quad V_1 + V_2$$

When   I   was an indicator,

V$_1$ was Variable 1.

V$_2$ was Variable 2.

The method of the additive combination aimed to compare what needed to be measured more than two systems how many units they were distinctive expressively. It was popular to propose the values of indicators gained from various equations based on the combination method in two cases which were as follows.

1. Variable synthesis by identifying a mean consisted of two cases as follows.

Case 1: Each variable was determined on equal weight as shown below.

$$I \quad = \quad (V_1 + V_2 + V3 + \dots Vn) / n$$

When I   = A sum of indicators

V$_1$ = Variable 1

V$_2$ = Variable 2

n   = The number of variables

Case 2: Each variable was determined on distinctive weight as shown below.

$$I \quad = \quad (W_1V_1 + W_2V_2 + W_3V3 + \dots W_nV_n) / W_i$$

When W$_1$ = Variable 1 weight

W$_2$ = Variable 2 weight

W$_i$ = Variable i weight

n   = The number of variables

2. Variable synthesis based on empirical data which was grouped on a basis of statistical criteria, such as the factor analysis as follows.

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$$I = (W_1Z_1 + W_2Z_2 + W_3Z_3 + \ldots W_nZ_n) / Z_i$$

When I = A sum of indicators

  W_1 = Variable Z_1 weight

  W_2 = Variable Z_2 weight

  Z_i = Standard scores of variables

  Z = $X - \overline{X}$ / SD

2.2.2 Multiplying combination: this method combined variable values together by multiplying. The basic assumption was that the change of one variable relied on a base of another variable which could not be compensated or replaced as shown below.

$$I = V_1 \times V_2$$

When I was a sum of indicators,

  V_1 was Variable 1.

  V_2 was Variable 2.

The combination method by multiplying was utilized to compare more than two systems and identify how many times or percentages one system was higher than the other system (Wanni Kamket: 1997: 2540). When combining variables by algebra combination method, it was popular to propose the indicator value via an arithmetic mean of the variables as shown below.

In case of the variables contained equal weight of importance,

$$I = \frac{V_1 + V_2 + V_3 + \ldots + V_n}{N}$$

In case of the variable contained distinctive weight of importance,

$$I = \frac{W_1V_1 + W_2V_2 + W_3V_3 + \ldots + W_nV_n}{\sum W_1}$$

  n = The number of variables

  $\sum W_1$ = A sum of importance weight of n variables

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When combining variables by multiplying combination, it was popular to present an indicator value by identifying a geometric mean of the variable as follows.

In case of the variables contained equal weight of importance,

$$I = \sqrt{V_1 \cdot V_2 \cdot V_3 \cdot \ldots \cdot V_n}$$ ………………..(1)

In case of the variable contained distinctive weight of importance,

$$I = \sqrt[\sum W_n]{V_1^{W_1} \cdot V_2^{W_2} \cdot V_3^{W_3} \cdot \ldots \cdot V_n^{W_n}}$$ ………………..(2)

The calculation of Equations (1) and (2) could be done via identifying a logarithm value as follows.

$$\log GM = \frac{\sum_{i=1}^{n} \log V_i}{n}$$

and $$\log GM = \frac{\sum_{i=1}^{n} W_1 \log V_i}{n}$$

The variable combination aforementioned in order to construct the indicators was in a form of a raw score which usually contained a problem regarding a distinctive variable measurement scale. In order to solve this problem, enable more accurate value, and be able to compare meaningfully, the raw score was supposed to be changed to a stand score as follows.

$$Z = \frac{X - \overline{X}}{SD}$$

   Z   =   Standard scores of variables

   X   =   Raw scores of variables

   $\overline{X}$ =   A mean of variables

   SD   =   Standard deviation of variables

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Therefore, the equation utilized to construct the indicators was as follows.

$$I = W_1Z_1 + W_2Z_2 + W_3Z_3 + \ldots + W_nZ_n$$

I = A sum of indicators

W_n = Variable n weight

Z_n = Standard scores of Variable n

In conclusion, there were generally two combination methods utilized to construct indicators which were additive combination and multiplying combination methods. The basic assumption of the additive combination method was based on the concepts that each variable could compensate or replace with another variable. On the contrary, the basic assumption of the multiplying combination method was that the change of one variable relied on a base of another variable which could not be compensated or replaced.

    2.3 Variable weight determination: when combining the sub-variables into an indicator, the researcher had to determine weight instead of the importance of each sub-variable. This could be done by two methods which were the equal weight and differential weight determination. And, this could be conducted by several methods as follows (Wannee Kamket: 1997: 22).

    2.3.1 An expert judgment: this was a consideration for agreement among the connoisseurs in a particular topic needed to study. Each member would propose the variable weight, and the consideration would complete by applying the mean or agreement discussion.

    2.3.2 An expert judgment without any encounter: the variable weight would be considered. Then, the importance weight of each variable would be given.

    2.3.3 Effort required measurement: time taken or cost spent in any activity regarding that particular variable would be considered. Empirical data and statistical methods in analyzing data were utilized to determine the importance weight of each variable. Factor analysis, multiple regression analysis, discriminant analysis, or canonical correlation analysis might also be utilized.

In conclusion, the methods in determining variable importance were not stable with solid criteria in which method would be the most appropriate. It depended on many components which were supposed to be considered together with theoretical concepts and data analysis. Once the data was gained, statistical concepts in analyzing data would be utilized to determine variable importance weight later.

Step 3: Data collection

The progressions of data collection for developing the indicator were the implementation to quantify the component variables which was commensurate to constructing the tools for measurement, the trial for utilization and improvement of the tool, including the checkup of the quality of the apparatus, the identification of population group and the sample size, and the visit to the field for trial use, information accumulation and check the quality of information which was the component variable which would later consolidated to be an indicator.

Step 4: Construction of indicators

In this stride, the researcher created the scaling or production of the indicator by bringing the component variables from the information gathered to investigate and afterward to be indicators. This was finished by the method for distinguishing weight of component variables and afterward consolidating the variables taking into account the definitions of indicators.

Step 5: Quality check of indicators

The information analysis to check the quality of developed indicator would cover the quality check of component variables and the developed indicators through tests on the reliability, validity, feasibility, utility, appropriateness, credibility, and consistency. The indicator that had quality would be utilized as information for administration and the system management.

Step 6: Contextualization and presentation

This stride was an important step of developing the indicator on the grounds that it was about communication between the researcher who was the developer of the indicator and the users of the indicator after its construction and the quality check of the indicators. The researcher had to break down the information to get value of the

appropriate indicator to the setting. The analysis could be done in the levels of area, province, district, organization, type of office personnel, or at full scale level. At that point, the researcher reported the value of indicator to the consumers or administrators, planners, researchers, including general academics to know and utilize the indicators widely.

2.3.2.3 Criteria for selecting indicators

Fitz-Gibbon (1996: 160-165) proposed the criteria for selecting the educational performance indicators and classified them into five groups of 12 aspects as follows.

1. Indicators were relevant which referred to as follows.
   1.1 Valued goals for distinguished units of management.
   1.2 Indicators referred to outcomes over which staff had influence.
2. Indicators were information which referred to as follows.
   2.1 Indicators were contextualized.
   2.2 Indicators were fed back to the units of management.
3. Indicators were acceptable which referred to as follows.
   3.1 Indicators were fair.
   3.2 Indicators were accessible.
   3.3 Indicators were explained.
   3.4 Indicators were incorruptible.
   3.5 Indicators were checkable.
   3.6 Indicators changed if the unit changed its performance over time.
4. Indicators were beneficial in terms of behavioral implications.
5. Indicators were reasonably cost-effective.

2.3.2.4 Concepts of factor analysis

1. Definition and background of the factor analysis

Factor analysis was a collection of methods utilized to examine how fundamental constructs influenced the reactions on a number of measured variables. Factor analysis were performed by examining the pattern of correlation or covariances between the observed measures. Measures that were exceptionally correlated either positively or

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negatively were likely influenced by the same factors, while those that were moderately uncorrelated were likely influenced by distinctive factors. In other word, factor analysis was by and large an exploratory or descriptive method that required numerous subjunctive judgments by a user. It was a broadly utilized tool, but could be dubious in light of the fact that the models, methods, and subjectivity were so flexible that wrangled about interpretations could happen. The method was similar to principal components in spite of the fact that factor analysis was more elaborate. In considering analysis results, the concepts of reasoning and distinguishing proof of names were employed (Kanlaya Wanitbancha: 2001).

2. Factor analysis techniques

There were two types of factor analysis which were (1) exploratory factor analysis and (2) confirmatory factor analysis. The details of these two types were as follows.

1. Exploratory factor analysis: it was exploratory when a pre-characterized idea of the structure or how many dimension were in an arrangement of variables was not distinguished. It endeavored to discover the nature of the constructs influencing an arrangement of responses.

2. Confirmatory factor analysis: it was corroborative when particular hypothesis was tested on the structure or the number of dimensions underlying an arrangement of variables.

There were four steps in conducting the factor analysis by a computer program which were as follows.

1. Data collection: the first step was gathering the applicable information for analysis on an arrangement of elements or objects for the variables of interest and setting up a covariance matrix, the information utilized directly in the factor analysis. These essential information needed to then be masterminded in a systematic way, usually called a data matrix.

2. Extracting initial factors: the second major step was to locate the number of factors that could satisfactorily clarify the observed correlations among the observed variables. There were several major alternatives as follows.

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2.1 Principal component analysis (PC)

2.2 Least square analysis (LC)

2.3 Maximum likelihood

2.4 Alpha factoring

2.5 Image

3. Rotation to a terminal solution: factors were rotated for better interpretation since unrotated factors were uncertain. The objective of rotation was to achieve an optimal straightforward structure which endeavored to have each variable load on as few factors as possible, but augmented the number of high loadings on each variable. There were two methods of rotation which were as follows.

3.1 Orthogonal rotation was when the factors were rotated 90° from each other, and it was accepted that the factors were uncorrelated. There were three orthogonal techniques as follows.

3.1.1 Quartimax included the minimization of the number of factors expected to clarify each variable.

3.1.2 Varimax minimized the number of variables that had high loadings on each factor and attempted to make small loadings significantly smaller.

3.1.3 Equamax was a compromise between Varixax and Quartimax criteria.

3.2 Oblique rotation was when the factors were not rotated 90° from each other, and the factors were considered to be correlated. There were two techniques of oblique rotation as follows.

3.2.1 Oblique rotation based on reference axes

Quartimin r = 0 most Oblique

Biquartimin r = .5 least Oblique

Convarimin r = 1 least Oblique

3.2.2 Oblique rotation without utilizing reference axes but a pattern matrix to rotate like Quartimax orthogonal rotation

According to the study, it was found that the orthogonal rotation was easily understood and interpreted.

2.3.3 Concepts of personal evaluation

2.3.3.1 Personnel evaluation standards

The personnel evaluation standards were developed by the Joint Committee Personnel Evaluation Standards, the United States (Rattana Buason: 2007, 240-244). The personnel evaluation standards were divided into four aspects consisting of the following indicators.

1. Propriety standards required that evaluations be conducted lawfully, ethically, and with due respect for the welfare of those evaluated and individuals included in. There were five indicators within this standard as follows.

1.1 Service orientation: evaluations of teachers were supposed to promote sound education principles, satisfaction of institutional missions, and compelling performance of job responsibilities, so that the educational needs of students, community, and society were met.

1.2 Formal evaluation guidelines: guidelines for personnel evaluations were supposed to be recorded and provided to employees in statements of policy, negotiated agreements, and personnel evaluation manuals, so that evaluations were consistent, equitable, and in accordance with applicable laws and ethical codes.

1.3 Conflict of interest: conflicts of interest were supposed to be distinguished and dealt with straightforwardly and honestly, so that they did not compromise the evaluation process and results.

1.4 Access to personnel evaluation reports: access to reports of personnel evaluation was supposed to be restricted to individuals with a legitimate need to survey and utilize the reports, so that appropriate utilization of the information was guaranteed.

1.5 Interactions with evaluates: the evaluation was supposed to address evaluates in a professional, circumspect, and considerate manner so that their self-esteem, inspiration, professional reputations, performance, and attitude toward personnel evaluation were enhanced or, at any rate, not unnecessarily damaged.

2. Utility standards were expected to guide evaluations so that they would be informative, auspicious, and persuasive. There were five indicators within the utility standards which were as follows.

2.1 Constructive orientation: evaluations were supposed to be constructive, so that they helped institutions to develop human resources and energize and assisted those evaluated to provide excellent service.

2.2 Defined uses: the users and the intended uses of a personnel evaluation were supposed to be distinguished, so that the evaluation could address appropriate inquiries.

2.3 Evaluator credibility: the evaluation system was supposed to be overseen and executed by persons with the fundamental qualifications, skills, and authority, and evaluators were supposed to conduct themselves professionally, so that the evaluation reports were regarded and utilization.

2.4 Functional reporting: reports were supposed to be clear, opportune, accurate, and pertinent, so that they were of practical value to the evaluatee and other appropriate audiences.

2.5 Follow-up and impact: evaluations were supposed to be followed up, so that users and evaluates were helped to understand the results and take appropriate actions.

3. Feasibility standards called for evaluation systems that were efficient, simple to utilize, sufficient funded, and politically suitable. The summary establishments for the three feasibility standards were as follows.

3.1 Practical procedures: personnel evaluation procedures were supposed to be arranged and conducted, so they delivered required information while minimizing interruption and expense.

3.2 Political viability: the personnel evaluation system was supposed to be developed and monitored cooperatively, so that all concerned parties were constructively included in making the system work.

3.3 Fiscal viability: satisfactory time and resources were supposed to be provided for personnel evaluation activities, so that evaluation plans could be effectively and efficiently implemented.

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4. Accuracy standards required that the obtained information be in fact solid and that the conclusions be connected intelligently to the information. The summary statements for the eight accuracy standards were as follows.

4.1 Defined role: the role, responsibilities, performance objectives, and required qualifications of the evaluatee were supposed to be unmistakably characterized, so that the evaluator could focus substantial assessment criteria.

4.2 Work environment: the setting in which the evaluation worked was supposed to be distinguished, depicted, and recorded, so that environmental influences and imperatives on performance could be considered in the evaluation.

4.3 Documentation of procedures: the evaluation procedures actually followed were supposed to be archived, so that the evaluatees and other users could survey the genuine, in connection to intended, procedures.

4.4 Valid measurement: the measurement procedures were supposed to be chosen or developed and implemented on the premise of the portrayed role and the intended utilization, so that the deductions concerning the evaluatee were legitimate and accurate.

4.5 Reliable measurement: measurement procedures were supposed to be chosen or developed to guarantee reliability, so that the information acquired would provide consistent indicators of the performance of the evaluatee.

4.6 Systematic data control: the information utilized in the evaluation was supposed to be kept secure, and was supposed to be deliberately processed and maintained, so as to guarantee that the data maintained and analyzed were the same as the data collected.

4.7 Bias control: the evaluation process was supposed to provide safeguards against predisposition, so that the evaluatee's qualifications or performance were assessed reasonably.

4.8 Monitoring evaluation systems: the personnel evaluation system was supposed to be reviewed intermittently and efficiently, so that appropriate revisions could be made.

According to the personnel evaluation standards aforementioned, it was summarized that the personnel evaluation was supposed to consist of four standards and 21 indicators which were five indicators in propriety standards, five indicators in utility

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standards, three indicators in feasibility standards, and eight indicators in accuracy standards.

2.3.4 Concepts of the performance evaluation system

The concepts of the performance evaluation system were presented in terms of definition and the elements of the performance evaluation system as follows.

2.3.4.1 Elements of the performance evaluation system

Many scholars proposed and analyzed the elements of the operational evaluation system distinctively as follows.

Crook (1972) proposed the elements of the operational evaluation system as follows.

1. Appraisal objectives
2. Appraisal standards
3. Weighting the function
4. Making the appraisal
5. Selecting the appraisal system
6. Management follow through

Castetter (1976) proposed the elements of the operational evaluation system as follows.

7. Position guides
8. Performance planning conference procedures
9. Performance appraisal procedures
10. Progress review conference procedures
11. Individual development program
12. Post-development program review conference

Borich (1977) proposed the elements of the operational evaluation system as follows.

13. Evaluation theory, mission, and effectiveness model
14. Monitoring subsystems of the performance evaluation
15. Data collection tools and treatment
16. Decision-making and actions

17. Recycling of the performance evaluation system

Tracy (1979, cited in Porntep Rupan: 2003, 57) proposed the elements of the operational evaluation system as follows.

1. Specify goals and objectives.
2. Decide on means to be utilized.
3. Determine criteria of performance.
4. Set standards to be met on criteria.
5. Measure performance.
6. Compare the evaluation with determined standards.

Henderson (1980) proposed the elements of the operational evaluation system as follows.

1. Job content analysis
2. Identification and description of responsibilities and duties
3. Establishment of performance standards
4. Setting desired and expected job results
5. Prioritizing and weighting job results
6. Designing and developing acceptable and effective performance identification and measurement instruments, and procedures
7. Supporting effective performance appraisal role behaviors
8. Measuring and reviewing appraisal job behaviors performance
9. Linking employee performance to organizational rewards

Stone (1981, cited in Pornthep Rupan: 2003, 58) proposed the elements of the teacher performance appraisal system summarized as follows.

1. Jobs and those who were assessed
2. Appraisal objectives
3. Standard criteria of the appraisal
4. Determination of the performance appraisal system
5. Application of the performance appraisal system
6. Collection and record of data gained from the performance appraisal

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Latham and Wexley (1981) proposed the elements of the operational evaluation system as follows.

1. Review legal requirement.
2. Conduct job analysis.
3. Appraisal instruction and training.
4. Inform the results of the appraisal process to the employees.

Mondy and Noe (1987) proposed the elements of the operational evaluation system as follows.

1. Identify specific performance appraisal goals.
2. Establish joy expectations.
3. Examine work performed.
4. Appraisal performance.
5. Discuss appraisal with employee.

Chusak Tiengtrong (1987) proposed the concepts regarding the elements of the performance appraisal process summarized as follows.

1. Determine appraisal objectives.
2. Select evaluating methods that were good and proper with the organizational needs and job description.
3. Determine operational standards.
4. Gain comprehension from assessors and those assessed.
5. Set proper time periods.
6. Set assessors.
7. Prepare appraisal forms.
8. Classify the assessors based on their types and expertise.
9. Train the assessors.

Strong and Helm (1991) proposed concepts regarding the elements of the teacher performance appraisal system summarized as follows.

1. Determine needs for the performance appraisal system.

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2. Link expectation of a performance appraisal project with teacher duty responsibility.

3. Select indicators regarding teacher performance.

4. Determine standards of teacher performance.

5. Prepare documents and data utilized in performance appraisal.

6. Operate teacher performance appraisal.

7. Communicate among all six elements.

Cascio (1992) proposed the elements of the operational evaluation system as follows.

1. Clarifying performance expectation

2. Setting goals.

3. Providing on the job advice and suggestions

4. Storing and recalling information about performance

5. Making and appraisal of the performance results

6. Providing feedback to employees for further modification

Byars and Rue (1997, cited in Pornthep Rupan: 2003, 59) proposed the elements of the operational evaluation system as follows.

1. Design the formal performance appraisal system.

2. Select the performance appraisal methods and instruments.

3. Train managers in conducting performance appraisal.

4. Maintain a reporting system to ensure that appraisal were conducted on timely basis.

5. Maintain performance appraisal records for individual employees.

6. Evaluate the performance of employees.

7. Complete the forms utilized in appraising the employees.

8. Review appraisal with employees.

Dessler (2000) proposed the elements of the operational evaluation system as follows.

1. Defining the job

2. Appraising performance

3. Feedback sessions

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Anthony et.al. (2002) proposed the elements of the operational evaluation system as follows.

1. Analyze jobs so as to adopt the results to determine standards.
2. Set performance standards.
3. Design the performance appraisal system.
4. Assess performance.
5. Performance review.
6. Discuss a future plan of action.

Hornsby and Kuratko (2002, cited in Pornthep Rupan: 2003, 60) proposed the elements of the evaluation system as follows.

1. Identify goals of the performance appraisal system.
2. Assess legal consideration.
3. Develop and select performance appraisal instrument.
4. Establish performance criteria, method, and goals.
5. Train managers to reduce rating errors.
6. Record work behaviors.
7. Evaluate employees.
8. Conduct performance appraisal interview.

Wittaya Kuwirat (1996) proposed the elements of the teacher evaluation system as follows.

1. Objectives of the performance appraisal
2. Personnel relevant to the performance appraisal
3. Content or standards utilized to evaluate performance
4. Tools utilized to evaluate performance
5. Appraisal processes
6. Performance outputs
7. Feedback of the performance appraisal system
8. Time period in operating the evaluation

Pornthep Rupan (2003) developed the performance appraisal system of the Commission of the Basic Education by proposing the elements of the performance appraisal system as follows.

1. Inputs consisting of:
    1.1 Objectives of the performance appraisal
    1.2 Appraisal indicators and criteria
    1.3 Tools and documents of the appraisal
    1.4 Assessors and those assessed
2. Processes consisting of:
    2.1 Planning for the performance appraisal
    2.2 Tool construction and development of the performance appraisal
    2.3 Performance data collection
    2.4 Data analysis and evaluation by comparing with the criteria set
3. Outputs consisting of:
    Summary reports of performance appraisal results in an overall group
4. Feedback data consisting of:
    4.1 Feedback data for educational boards
    4.2 Feedback data for educational service areas

According to the concepts regarding the elements of the performance appraisal system aforementioned, it could be summarized on a basis of the key system element frame in terms of four elements which were inputs, processes, outputs, and feedback as follows.

1. Inputs consisting of:
    1.1 Objectives of the performance appraisal
    1.2 Personnel relevant to the performance appraisal
    1.3 Content or standards utilized in the performance appraisal
    1.4 Performance appraisal tools
    1.5 Appraisal operation time periods
2. Processes consisting of:
    2.1 Training for assessors
    2.2 Steps and processed in evaluating performance
    2.3 Monitoring appraisal

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3. Outputs consisting of:

    3.1 Summary reports of performance appraisal

4. Feedback data consisting of:

    4.1 Communication of data to those assessed and offices

    4.2 Inspection and revision of the performance result

2.4 Concepts of developing and enhancing teacher competency

Guskey (2000, cited in Sermsak Wisalaporn: 2002) stated that a teacher development model was as follows.

    1. In-service training: in-service training was the most widely recognized or conventional form of professional development. It regularly happened amid a foreordained period of time during which a presenter drove and shared ideas and expertise to participant teachers. It might incorporate distinctive kinds of group-based activities, presentations, and discussions. Training might come through several formats like workshops, colloquia, demonstrations, role-playing, and simulations. It was viewed as a cost-effective model since large groups of teachers were reached at once. The same knowledge base was imparted to all participants.

    2. Observation: observation was another model of professional development that included colleagues who provided feedback based on observations about the performance of fellow instructors. Both the observers and the observed learned from the process.

    3. Development/improvement process: development/improvement process was a professional model in which the participant teachers were called together to make decisions and changes in organizational plans, procedures and activities. It might oblige participants to basically review organizational programs, curriculum and instruction, or decisions made on particular problems.

    4. Study groups: the utilization of study groups was utilized to touch base at solutions to common problems. It regularly included teacher participants from numerous academic institutions. The participants were generally placed into groups of four to six members, and each group was required to concentrate on distinctive aspects of the problem. Recommendations and findings of each group were later imparted to the entire population of the participants. Study groups gave interesting opportunities for

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all the members to work together and bring focus to improvement efforts. Study groups prepared the way for professional learning communities and provided opportunities for continuous professional development.

5. Action research: it emerged as a prevalent tool for professional development especially in educational settings. It was depicted as a self-reflective form of inquiry attempted by participants in educational circumstances to enhance their practices or comprehension of these practices. In terms of teacher professional development, it was beneficial for teachers to conduct research about their classroom practices and teaching skills as a major aspect of an action research process. In general, there were five steps identified in the action research as follows.

5.1 Select issues or address problematic issues.

5.2 Collect, systemize, and interpret the information regarding the issues.

5.3 Study documents and relevant research.

5.4 Select practical methodology that could achieve shared objectives.

5.5 Solve problems and record the findings.

6. Mentoring: mentoring included pairing a more experienced practitioner with a less experienced teacher. This pair decided to have general encounters to discuss objectives, issues, and problems, and to make on-the-job observations. The pair likewise reflected on their practices. This model encouraged lifelong and profitable professional development relationships.

Sparks and Loucks-Horsley (cited in Ubben et.al: 2001) proposed five teacher development models as follows.

1. Individually-guided development: it regarded the reason that teachers ceaselessly learned things on their own. Teachers selected their own particular objective and develop individual plans to seek after their desired outcomes. Teachers might read professional literature distinguished with an area of characterized interest, research an area of concern, or perform a case study on a student. This model was effective for adult learners as they were self-guided and prepared to learn when they recognized a need.

2. Observation and assessment: this might happen in a variety of ways. The principal might serve as the observer and provide feedback to the teacher concerning classroom observations of the teacher's classroom practices. Teachers regularly viewed this more as evaluation than as a type of staff development. Another form of observation and assessment, peer coaching, might be placed in this category and was considered as advantageous for teacher learning. Aside from peer coaching, team building, coordinated effort, and clinical supervision could be utilized as well.

3. Involvement in a development process: teachers contributed to a variety of school improvement processes. They were sometimes requested to develop or adapt curriculum, design programs, or participate in systematic school improvements processes that had as their objective the improvement of classroom instruction and curriculum. Regularly, these projects were started to solve a problem. Their successful completion might require that teachers acquired particular knowledge or skills. Additionally, they served on numerous committees to evaluate and reflect on current school-wide and district-wide practices. This model concentrated on the combination of learnings that outcome from the inclusion of teachers in such development/improvement processes.

4. Training: it was the most well-known form of staff development. Teachers attended workshops or beginning of the year in-services without follow-up or support. As a rule, an expert shared knowledge that was viewed as profitable. Because numerous teachers might be trained at one time, this was a cost-effective form of staff development. In spite of the fact that peer interaction at the training session may be beneficial, further support was expected to support effective implementation.

5. Inquiry: the inquiry model of staff development was rarely utilized. Teachers were encouraged to ask critical inquiries, assemble information, reflect, and share their knowledge. Through request, teachers might distinguish essential inquiries that extended beyond the vision of the external researcher. Teacher inquiry might be a single activity, be done in small groups, or be conducted by a school faculty. Its procedure might be formal or informal. It might happen in a classroom, at a teacher center, or result from a university class. In this section, teacher inquiry was investigated as a staff development model. One of the imperative fundamentals of the inquiry

approach was that research was an important activity in which teachers were supposed to be engaged, in spite of the fact that they rarely participated in it other than as subjects.

The National Institute for Development of Teachers, Faculty Staffs, and Educational Personnel (2006) determined a new trend of a conceptual frame for developing teachers and educational personnel in Thailand as follows.

1. Teacher development had to enable changes in students.

2. Development had to be derived from teacher needs as planned in a competency frame provided in an individual development plan of teachers.

3. Development methods needed to be numerous and appropriate to themselves, for example internal development of educational institutions – peer-to-peer development, classroom action research, self-study, distant self-study via e-learning publishing media, etc. – at least once a year.

4. Evaluation outcomes needed to be connected with promotion of academic standing and merit consideration, including renewing of professional license with relevant offices.

Aporn Phuwittayapan (2007) mentioned about personnel development guidelines which could be utilized to construct teacher development guidelines as follows.

1. On-the-job training (OJT): learning in the real working environment under supervisor, which was suitable for new staffs in the organization.

2. Coaching: new employees were coached by their director under the same objectives in order to improve potential and position development in the future.

3. Self-learning or knowledge management: the employees were emphasized to take a responsibility in learning and developing themselves from the assignment task.

4. Visiting: this tool was always utilized in management level employees. The objective of this tool was to get the new useful idea from domestic or oversea organizations and adapt into own organization.

5. Meeting and seminar: inviting experts from inside and outside the organization to train and discuss in a particular topic with employees in order to expand the experience and aspect could help improve personnel.

6. Job enrichment: assigning more challenging tasks to improve multi skills of personnel was a development by means of increasing knowledge.

7. Continuous studying: this enhanced and supported personnel to further their studies which could upgrade the personnel quality.

8. Job rotation: rotating some employees to another task to learn new working process and gain new working experience in the period of time. Moreover, this tool could improve the relationship among employees.

9. Activity: the target group of employees would be assigned in the activity that improved the desired skills or knowledge.

The Office of the Education Council (2009) determined current guidelines in developing teachers, instructors, and educational personnel in Thailand as follows.

1. Adjust and develop systems and criteria in evaluating teacher professional competency so that it was connected with an ability in teaching and learning management in order to develop students ultimately.

2. Accelerate the establishment of the funds in developing and enhancing teachers.

3. Develop teachers on a basis of school-based management so as to be able to manage teaching and learning on a fashion of student-centered manner.

4. Develop teachers, administrators, and personnel both vocational and higher educational levels to be able to manage teaching and learning, research, and develop innovation and technologies.

2.5 Relevant Research

The following research was relevant to mathematics teacher competency conducted by scholars both domestic and foreign. The researcher presented the research relevant in three parts which were the research regarding the development elements and indicators of mathematics teacher competency, the research regarding tool construction and

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mathematics teacher competency evaluation, and the research relevant to the guidelines in developing and enhancing mathematics teacher competency as detailed below.

2.5.1 Research regarding the development elements and indicators of mathematics teacher competency

Phikul Sonachote (2001) conducted research on "Mathematics Teachers' Performance regarding Teaching Effectiveness Factors as Perceived by Students with Different Learning Achievements in Secondary Schools under the General Education Department in Educational Region 9." It was found that the students all in all and the students with high and medium learning accomplishments indicated opinions about mathematics teachers' performance according to teaching effectiveness factors in general and in four aspects at a more level and the aspect of teaching activities at a medium level. Except the students with high learning achievements showed opinions about teaching activities at a more level. Though, the students with low learning accomplishments indicated opinions about teachers' performance in general and in four aspects at a medium level and in the aspect of teachers' personality at a more level. The students with distinctive learning accomplishments demonstrated opinions about mathematics teachers' performance according to teaching effectiveness factors in general and in five aspects differently at the 0.01 level of significance.

Prapasri Suthapa (2001) concentrated on "Construction of Desirable Characteristics Scale for Primary School Mathematics Teachers." It was found that mathematics teachers were supposed to possess seven characteristics which were (1) teaching capability characteristics, (2) special characteristics of mathematics teachers, (3) special personality appropriate for being mathematics teachers, (4) attitude towards being mathematics teachers, (5) understanding of curriculum characteristics, (6) teaching planning and classroom research characteristics, and (7) measurement and evaluation characteristics.

Chalermpol Posri (2003) conducted research on "An Analysis of Supporting Factors of Mathematics Teachers' Teaching Efficiencies in Educational Opportunity Extension Schools under the Office of Si Sa Ket Provincial Primary Education." It was found that there were eight supporting factors of mathematics teachers' teaching efficiency. These

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factors were (1) mathematics teacher personality, (2) learning-teaching arrangement, (3) knowledge of teaching profession, (4) responsibility for the duties, (5) learning-teaching climate and environment, (6) uses of learning-teaching media, (7) uses of learning psychology, and (8) the teachers' background.

Piangjai Jongnok (2004) conducted "A Study of the Qualities in accordance with Professional Standard of Mathematics Teachers in Nakhon Ratchasima Educational Service Area Zone 5." The results of the study revealed that the qualities in accordance with professional standard of mathematics teachers in Nakhon Ratchasima Educational Service Area Zone 5 in the opinions of the administrators or academic teachers were at a high level in the whole three sections which were knowledge, expressing, and the ability. The comparison of the qualities in accordance with the professional standard of mathematics teachers of Grades 1-2 and mathematics teacher of Grades 3-4 was not distinctive in terms of statistics at .05 level.

Taweesak Suttipanyapakorn (2006) conducted research on "Factor Analysis of Teaching Efficiency of Mathematics Teachers according to the Secondary School Students Perspectives in Pattani." Six factors on teaching efficiency of mathematics teachers in secondary schools were found. They were teacher characteristics, instructional knowledge and ability, ability in utilizing instructional media, emphasis on student-centered activities, giving advice and help for students, and measurement and evaluation.

Suphaphan Chairuen (2008) conducted "A Study of Mathematics Teachers' Standards at the Secondary Education Level in the Basic Education Institutions, Bangkok Educational Service Area Office 2." The study revealed that the mathematics teacher standards at the secondary education level in the basic education institutions under Bangkok Educational Service Area Office 2 was at a good quality level in three aspects which were expression, knowledge, and teaching competency. The comparison between two groups with distinctive achievement tested by the National Test was not distinctive in the overall three aspects. However, there was statistically significant difference at .05 on expression when an individual aspect was considered.

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Wassana Sang-ngam (2009) studied "Mathematics Teacher's Competency Relating to Their Teaching Efficiency of Grade 3-4." The results of the study were as follows. Teaching competency of mathematics teachers included five principal factors which were subject knowledge, personality and academic leadership, attitude, measurement and evaluation, and the teacher-student relationship.

2.5.2 Research regarding tool construction and mathematics teacher competency evaluation

Kullavadee Phaijit (2001) studied "The Roles of Mathematics Teachers according to National Education Acts in 1999 for Mathayom Suksa 6 Students under the Department of General Education: Khon Kaen Province." The analysis of information uncovered that the mathematics teachers' role in encouraging and supporting was found at a high level while instructional management, contributing positive climate, classroom management, and monitoring and assessment were found at a moderate level.

Porntip Kawtawee (2002) conducted "A Study and a Comparison on Basic Mathematical Competencies of Mathematics Teachers in the Lower Secondary Schools under Equity of Secondary Schools Project, Office of the National Primary Education, Nakhonsrithammarat Province." It was found that all mathematics teachers at the lower secondary schools had average basic mathematical competency higher than 50 percent. The highest was the effective competency. The teaching competency was moderate while the cognitive competency was the lowest.

Piyapan Chaisena (2006) conducted research on "The Development of Instruments to Evaluate Competency for Learning Management of the Fourth Level Mathematics Learning Area Teachers under the Offices of Nakhon Phanom Educational Service Area." The employed research instruments comprised an interview structure, a question and learning management competency evaluation form for fourth level mathematics learning area teachers. Research findings showed that (1) the construct instrument to evaluate competency for learning management of the fourth level mathematics learning area teachers consisted of two assessment forms: the first form was the 39-item assessment from on learning management skills and personality of the fourth level mathematics learning area teachers, and the second form was the 19-item assessment

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form on students' attitudes toward learning management of the teacher; and (2) results of quality verification showed that the constructed instrument had criterion-related validity and reliability coefficient of .87.

Piyawan Krainara (2006) conducted a study entitled "The Development of Mathematics Activity Packages to Encourage Problem–Solving Ability on Ratio and Percentage for Mathayom Suksa II Students, Ban–Kalisa School of Amphoe Ra–ngae Narathiwat, Primary Educational Service Area Office 3." The findings of the research were (1) the mathematics activity packages to encourage problem-solving ability on ratio and percentage for Mathayom Suksa II students were at the highest level of the suitability at the average of 4.46 which met the efficient standard criterion of 84.19/81.23, which was higher than selected efficient standard criterion of 80/80. (2) The problem-solving ability of Mathayom Suksa II students after utilizing the mathematics activity packages was higher than before learning through the packages at the average of 40.17percent. (3) Students' satisfaction toward the mathematics activity packages was at the highest level. The average of the satisfaction level was 4.72.

Puangpet Boonyapattaro (2008) conducted research on "The Assessment of the Efficiency of the Teachers in the Project for Promotion of the Production of Teachers with Special Competencies in Science and Mathematics in accordance with the Science Teachers Standard and the Mathematics Teacher Standard of the Institute for Promotion of the Teaching of Science and Technology." It was found that there were ten standardizing criteria with 80 indicators. Moreover, the assessment outcome in the opinions of the administrators and the teachers passed the assessment criterion at the level of good for all the ten standards and all the indicators in areas of knowledge, expression, and competency.

Ratsamee Seehanun (2008) researched on "An Evaluation of Teacher Capabilities of Teacher Officials Attached to Ubon Ratchathani Office of Educational Service Area 3." The research instrument was the teacher capability evaluation form with a five-level Likert scale, which yielded the reliability value of 0.8027. The research findings were as follows.

1. There were 79 sub-indicators for the teacher capabilities: 8 sub-indicators for love, generosity, and well-wishing for learners, 5 sub-indicators for patience and responsibility: 12 sub-indicators for learning and academic leadership; 6 sub-indicators for vision; 13 sub-indicators for the passion for teaching career; and 35 sub-indicators for ethical practice in teaching career.

2. When compared with the evaluation criteria, all aspects of the teacher capabilities, namely love and generosity, well-wishing, patience and responsibility, learning and academic leadership, vision, passion for teaching career, and ethical practice, were found to be at a high level with a mean between 4.04 and 4.43.

Sophon Yamtongcome (2009) conducted research on "The Development of Teachers' Characteristics Enhancement Model of Government Teachers in the Scholarship Project of the Promotion of Science and Mathematics Talented Teachers (PSMT)." It was considered the research and development with mixed methods research. The instruments utilized in the study included (1) the model manual, (2) the assessment form of teachers' characteristics, and (3) the assessment form of satisfaction from the usage of the model. The results of the research were as follows.

1. The characteristics of government teachers in the scholarship project of the Promotion of Science and Mathematics Talented teachers needed to be enhanced were (1) ability of thinking included creative thinking and logical thinking and (2) ability of expression included communication skills, human relationship, and leaderships.

2. The learning procedure for government teachers in the scholarship project of the Promotion of Science and Mathematics Talented Teachers that was achieved from the model development (A-STAR Model) consisted of five steps, namely (1) Assessment of Needs: A, (2) Sharing Experience: S, (3) Team Discussion: T, (4) Action: A, and (5) Reflection: R.

3. The study results of the effectiveness of the model were as follows.

3.1 The statistical significance of the overall average level of teacher's characteristics for the experimental group was .05 higher than that before the test of and the control group. The sample was revealed that the experimental group had a clear intention to attend the training which they found suitable and relevant to their needs.

3.2 The statistical significance of the overall relevant average level of teacher's characteristics after the implement was .05 higher than that before the implement of A-STAR model. And, teachers had the confidence in the development of teachers' characteristics under an advice of an expert.

3.3 The level of satisfaction from the model to enhance teachers' characteristics among the experimental group was high. Teachers had started to learn by themselves and they were enthusiastic to participate in the cooperative learning method.

3.4 The gifted science and mathematics teachers in the scholarship project presented continuous improvement in their teachers' characteristics after the first, the second, and the third months. And, there were strong supports for the continuity of the project included coaching, supervising, and monitoring the achievement of the proceeding projects in the school.

Wotruba and Wright (1975) conducted research on "How to Develop a Teacher Rating Instrument." The sample groups of the research were administrators, instructors, and university students at San Diego State University. They distinguished the following six characteristics of an effective instructor which were (1) knowledge of and enthusiasm for the subject matter and teaching, (2) good organization of subject matter and course, (3) effective communication skills, (4) positive attitude toward students, (5) fairness in evaluation and grading, and (6) flexibility in approaches to teaching.

Shian Leou (1998) from Kaohsiung Normal University, Taiwan, researched on "Teaching 68 Competencies Assessment Approaches for Mathematics Teachers" whose objective was to create a list of evaluation items for mathematics teachers. The study results classified the list of evaluation items into four aspects, i.e., teaching skills, arrangement of the material supplier media system and presentation, learning climate creation, and attitude toward the teaching.

A.G. Alnoor (2001) from China Central Normal University conducted the research aiming to identifying the professional efficiencies for the intermediate schools mathematics teachers and tried to know at what level the mathematics teachers experienced those competencies. The researcher utilized a descriptive research

approach, the study data collected from specialist educators and teacher's experts and previous studies to determine the mathematics teaching competencies. To know how the mathematics teachers applied those competencies the researcher distributed a questionnaire to 45 teachers after testing its validity and computing its reliability through person correlation coefficient which was 88%. The study created a list of necessary competencies for mathematics teachers, and showed the degree experience those competencies by the teachers.

Nicole (2008) conducted a study to explore the relationship between teacher knowledge and student learning in the area of mathematics by developing and evaluating an innovative approach to assessing teacher knowledge. This approach was based on teachers' analyzes of classroom video clips. Teachers watched 13 video clips of classroom instruction and then provided written comments on the interactions of the teacher, students, and content. The quality of teachers' analyzes, coded utilizing an objective rubric, were shown to be reliable and valid, relating both to another widely utilized measure of teacher knowledge and to teachers' own students' learning (from pre- to posttest).

According to the aforementioned research, it was found that the indicators, and indicators of the mathematics teacher competency evaluation had to respond student needs leading them to mathematics learning. The evaluation model was gained from analyzing and synthesizing mathematics teacher competency, designing, inspecting, actually applying, and model examination. In addition, it was found that the teacher evaluation model, an evaluation model of mathematics teachers, and evaluation guidelines to construct evaluation criteria involved teacher knowledge and ability, teacher characteristics, teaching efficiency, and the motives teachers built among students.

2.5.3 Research relevant to the guidelines in developing and enhancing mathematics teacher competency

Domestic research

Nittaya Choptham (1996) concentrated on the "Needs for Improving Mathematics Teaching Competencies of Prathomsuksa Six Teachers under the Office of Surat Thani Provincial Primary Education" in four areas which were contents, instructional process, instructional aids, and assessment and evaluation. It was found that teachers needed to improve their mathematics teaching competencies in all four areas by workshop on mathematics teaching which were rated high. As for the content, competency improvement in teaching addition, subtraction, multiplication, division, natural numbers, fractions, and decimals was required.

Jarueyporn Tonganun (1997) studied the "Needs of Teaching Competency Development of the Elementary School Teachers in Changwat Nakhon Si Thammarat." It was found that the general needs and also those of particular areas of teaching competency development of the primary teachers were at a high level. The needs of teaching competency development of the elementary school teachers in descending order of importance were as follows: instructional activity implementation, teaching preparation, instructional measurement and assessment, remedial teaching, classroom atmosphere creation, and instructional media use, respectively.

Sumpun Intawong (1997) developed "Training Curriculum Development for Competency Enrichment of Secondary School Mathematics Teachers in Mae Hong Son Province" by surveying trouble and needs in preparing of secondary school mathematics teachers in Mae Hong Son Province. The results of the data analysis could be summarized that teachers needed to build up their competency firstly in the area of process-focused lesson planning. As to the preparation procedures, they needed to be prepared in a practical way, conceptualizing, and analyzing problems in groups. The results of curriculum implementation expressed that the teachers had more learning and comprehension in each topic area than they had before the preparation at the significance level of .01.

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Sombat Sritongin (2006) studied professional teacher characteristics to create a model for developing professional teacher characteristics of students of Faculty of Education in Nakhon Sawan Rajabhat University. The research methodology was a descriptive research, utilizing a professional teacher characteristic questionnaire conducted by the researcher. The model for developing professional teacher characteristics was considered by seven experts. The research finding were as follows.

1. The professional teacher characteristics of students: students had knowledge at a less level on educational research and English. As for the technical method, students had knowledge at a less level on how to build and develop the media to prepare teaching forms. As for personality characteristics, they had attitude at a less level on how to use the language, dresses, punctuality, and attitude to be a teacher.

2. The model for developing professional teacher characteristics among students: there were supposed to be seminar and meeting on educational research and the English language for communication. This could help build and develop the media and plans to prepare their teaching. Students were supposed to be trained so as to develop their personality characteristics and punctuality. Inviting well-known professional teachers to help train them could be used as well.

Aponrat Saratassananun (2008) conducted the research on mathematics teacher development in order to develop mathematics student ability in the primary schools under jurisdiction of the Educational Service Area Loei I. The target sites were two primary schools 'A' and 'B.' Mixed methodology was utilized which was (1) the quantity research tools, a test of mathematics teacher knowledge, a mathematics achievement test, and a student attitude test towards mathematics, and (2) the qualitative tools consisting of the question items for AIC and interview, observation, and filed notes. Quantitative data were analyzed by appropriate statistics of a data level, such as percentage, mean, and standard deviation. T-test was utilized for assumption test; content analysis and triangulation approach were utilized for qualitative data. The research findings were as follows.

1. Conditions and problems: most teachers from two schools lacked knowledge in almost all mathematics content and elementary mathematics teaching

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methods, such as writing mathematics processes, skill objectives, methods and techniques in teaching mathematics, teaching aid usage, measurement, and evaluation. Teachers always utilized lecture and did not use various methods of teaching. Furthermore, teachers did not teach based on their lesson plans and did not use enough teaching aids. They had problems on creating exercises and measuring irrelevant to three aspects of objectives. When compared with other subjects, students did not like mathematics. They were not interested in learning, lacked responsibilities, did not do homework, and did not realize the value of learning mathematics. Parents could not teach their children homework.

     2. Teacher development activities: they consisted of academic field trip in order to develop learning and teaching quality, training on teaching and learning activities, mathematics camps, and classroom action research. Therefore, teachers could apply their knowledge to their instruction and develop student mathematics ability through 'Learner Development to be Excellent Projects.'

     3. The results of teacher development: teacher instructional change was distinguished in classroom activities. Due to this development, teachers were enthusiastic in developing instructional activities more effectively and had positive attitude towards mathematics activity conducting. Moreover, teachers collaborated in student development activities increasingly.

The mean of mathematics learning achievement of students from both schools was significantly distinctive between pre- and post-development in all classes at a level of 0.01. The mean of calculation skills and student problem solving were significantly distinctive between pre- and post-mathematics warm-up package usage in all classes, except Prathom Suska 6 of 'A' school which was not distinctive at a level of 0.1. It was found that student attitude towards mathematics in both schools was at a high level and their behavior revealed that students participated more in mathematics activities.

Visoot Weangsamoot (2010) developed a learning organization development model for mathematics teachers in the first and second class intervals. The research was conducted by means of an action research. The tools utilized to collect data were a questionnaire, an observation form, an achievement test, and a note of meeting. The

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statistics utilized were mean, standard deviation, percentage, and paired t-test which was utilized to test a hypothesis. It was found that (1) mathematics teachers possessed an improvement level of instructing quality. They needed to be trained in a professional student-centered type of learning. (2) The teacher development model of learning organization for mathematics teachers in the first and second class intervals consisted of six steps which were analyzing problems, planning, improving, doing, checking, and managing knowledge. After trying out the model, teachers were fulfilled by the proposed model at the highest level. They could change their teaching behaviors from teacher-centered to student-centered types. They likewise possessed ability in teaching at a medium level.

Kesorn Thongsaen (2010) conducted the research on "Teacher Development Based on Mathematics Teaching Professional Standards through Lesson Study" in order to study the mathematics learning achievement of students taught by mathematics teachers obtaining development by utilizing lesson study during Academic Years 2008-2009. The research tools consisted of an assessment form of mathematics teachers, a mathematics learning achievement test, an observation record form, a teacher standard evaluation form, and an interview form. The data were analyzed by the content analysis, percentage, mean, and standard deviation. The research findings were as follows.

1. In terms of mathematics teacher standard evaluation of teachers obtaining development by utilizing lesson study, everyone was at a very good level. Their evaluation scores were between 85.25 and 90.50. The percentage average scores were 88.25 which was at a very good level.

2. In terms of mathematics teacher professional standard, the learning achievement of the students taught by teachers developed by utilizing lesson study, it was found that the students had development and change in confidence, assertion, and good attitude towards mathematics learning, mathematics process skills, and social skills at a higher level.

Ronnakorn Nonyaso (2013) conducted research entitled "Guidelines for Teacher Development in Basic Education Schools in the Future" by interviewing 17 experts.

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The study discovered the following findings masterminded from the highest median value of each aspect.

1. An approach to build up a teacher preparation system before entering the position in the essential education in the future: extraordinary required knowledge, abilities, and experience.

2. An approach to develop and promote the utilization of teachers in professional life in the future: raising the professional level was supposed to be lifted, and personal systems in schools were supposed to contribute to the self-awareness needs of the individual.

3. An approach to improve the teacher quality in the future: teacher characteristics were supposed to have spirit of being teachers, love and have faith in their teaching profession, possess lifelong learning, plan and work together as a team, possess virtue, and possess knowledge and ability in utilizing information technology (IT).

4. An approach to develop an appraisal system for future teachers: institutions or offices overseeing teaching profession were supposed to possess an intermittent assessment of ability with a standardized evaluation system. The assessment in a form of committees at all levels was supposed to be set. The results of the assessment were supposed to join with the remuneration and academic standing.

According to the aforementioned research, it was found that guidelines in developing and enhancing mathematics teacher competency relied on the study of conditions, problems, teacher needs, guidelines determination, and comprehension creation and satisfaction. This would lead to teacher goals in operating mathematics teaching and learning successfully.

As for mathematics teacher competency evaluation based on the study of documents and relevant research, it was found that the model used to evaluate mathematics teacher competency was supposed to be considered the analysis and the synthesis of mathematics teacher competency which would lead to the design and evaluation of the model. It was supposed to be examined and modified. The steps in evaluating the efficiency of the model and three key competency elements which were (1) mathematics knowledge competency, (2) skill competency in managing learning

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activities, and (3) competency of characteristics and attitude were supposed to be focused. The method of factor analysis was a popular method utilized to analyze structural validity of elements and indicators. Mathematics teachers also needed to develop those competency aspects so as to use them as guidelines in managing mathematics teaching and learning leading to basic education achievement in terms of curriculum goals later.

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| Elements and indicators of mathematics teacher competency in the lower secondary schools | Quality of the elements and indicators of mathematics teacher competency in the lower secondary schools:
1. Content validity
2. Structural validity
3. Reliability | An evaluation model of mathematics teacher competency in the lower secondary schools:
1. Evaluation goals
2. Evaluation scopes
3. Evaluation operation
  3.1 Assessor qualification
  3.2 Evaluation tools
  3.3 Evaluation methods
4. Evaluation result judgment
5. Reporting and result application | Quality of the mathematics teacher competency evaluation model:
1. Utility
2. Feasibility
3. Propriety
4. Accuracy | Guidelines in developing and enhancing competency:
1. Content knowledge
2. Skills in managing learning activities
3. Psychological characteristics in developing students, virtue, morality, and professional ethics |

Mathematics teacher competency:
1. Competency concepts
2. Teacher profession standard criteria and teacher professional ethics
3. Mathematics teacher standards of IPST
4. Mathematics teacher competency from relevant research
5. Teacher competency in 21st century and foreign country

Indicator development concepts:
1. Indicator definition
2. Variable selection
3. Variable combination
4. Indicator weight determination
5. Indicator quality examination

General System Theory of Von Bertalanffy (1968):
1. Inputs
2. Processes
3. Outputs
4. Feedback

Concepts of the Joint Committee on Standards for Education (1988)

Competency enhancement and development concepts
1. The Office of the National Education Commission (2000)
2. Guskey (2000)
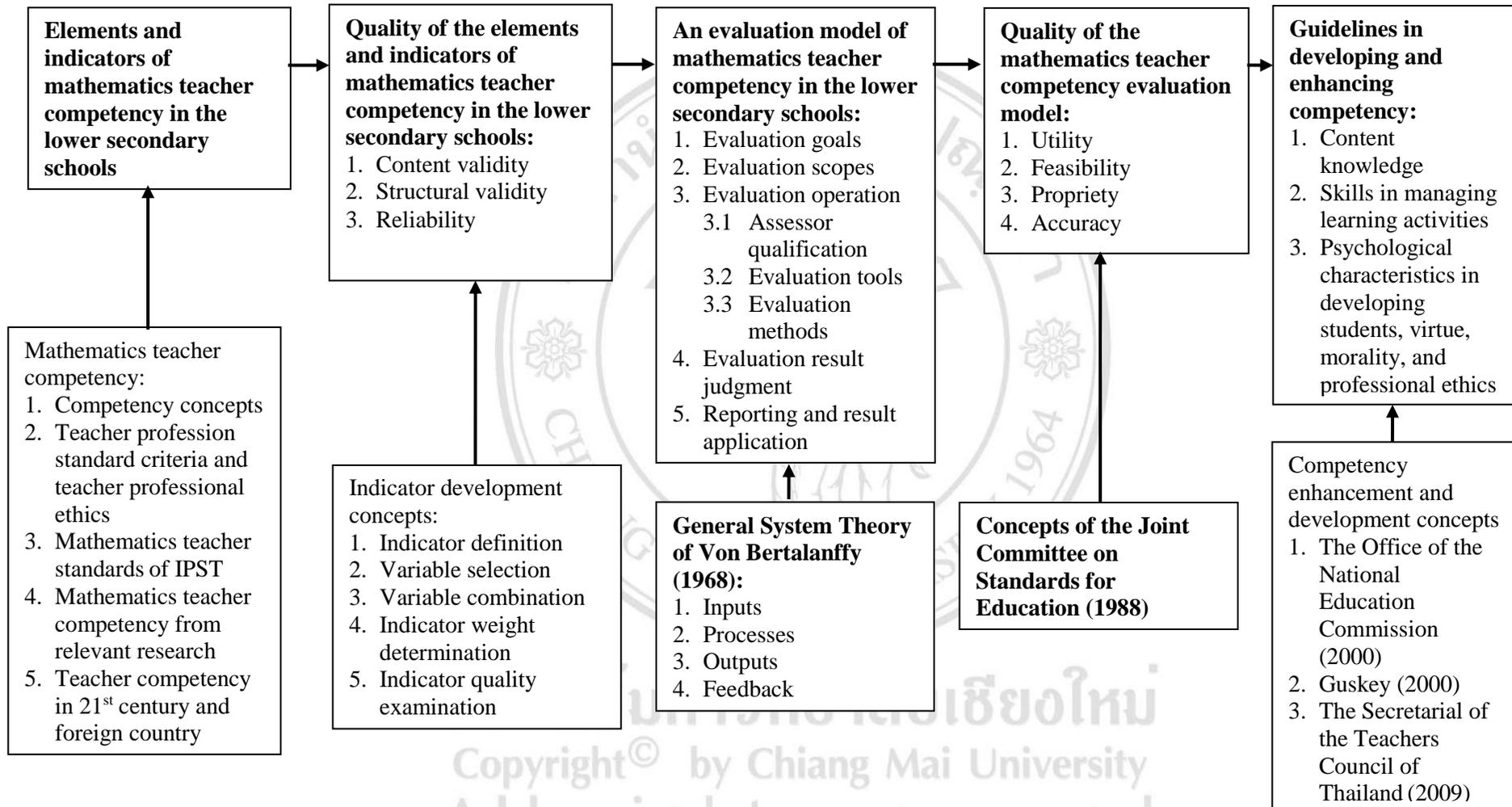3. The Secretarial of the Teachers Council of Thailand (2009)

Figure 2.1 Conceptual Frame of the Evaluation Mathematics Teacher Competency in the Lower Secondary Schools

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