

# An Increasing of Primary School Teachers' Competency in Brain-Based Learning

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## Abstract

The purpose of the study was to develop a powerful and empowering guide (CBT) of elementary school teachers, to compare the ability of elementary school teachers. Management learning uses brain as a base. The experimental group with a control group the experimental group used in this research was a teacher at the grade level. 4-6 in province By randomization group (Cluster Sampling) 2 Education Service Area Office, District 15 schools, three people were 90 percent of the control group in this study is grade 4-6 teachers in the Samut Songkram Province has a total of 90 people selected by model. The instruments used in the trial include training courses Empowerment (CBT) of elementary school teachers. After training, the test results of 60 studies found that the development of training courses to increase the capacity of the elementary school teachers. The experts found that the overall effectiveness of the program at the highest level. Before and after the process of empowerment (CBT), t equals 58.01 posttest scores higher than the previous level of statistical significance .05, comparing the capabilities of elementary school teachers. The experimental group with the control group, the experimental group was 47.98 t test scores than the control group, the experimental group had a statistically significant level .05.

**Keywords:** brain-based learning, primary school, teachers, competency

## 1. Introduction

Organizing learning activities upon the concept of brain based learning is designing learning process through understanding brain. It is a kind of instruction started from stimulating students to feel fun and challenged for knowledge seeking. If this operation can be performed, other problems that have been obstacles for long period may no longer difficult. Learning process design based on brain understanding is arranging learning procedures of humans that is the important foundation for obtaining new concept, skills, and knowledge. Repeated study, experiments, and actions make brain feel familiar with the concept and learning process of brain is not originated by emptiness but it is created from existing knowledge of students that may be scattered and incorrect or correct. We call this kind of knowledge as old schema.

To make children learn anything, the first thing to do ordering their existing knowledge and promoting such knowledge to reach deeper understand. When children can think abstractly, their brains are more developed because their abilities to connect thought and imagination are expanded. Brain based learning activities management is a kind of learning emphasizing on students mainly. These activities give some opportunities to students to take action, study, and build new knowledge or works through mutual thinking and doing. In addition, they also exchange knowledge and learning enabling students to practice their learning abilities or skills through brain based learning. This is a kind of repeated instruction through various activities emphasizing to enable students to learn systematically by themselves. Brain based learning emphasizing on students requires variety of activities, for example, cooperative group, mind mapping and games. The principles of brain based learning and student-centered learning allow teacher to make learning process flexible upon appropriateness of contents. Brain can learn properly through practice and being in virtual situations. It can be seen that if we read any tale with pictures, children will not listen to the meaning of such tale but they will create their own imagination along with that they listen to and see. Brain can learn properly when the mind map is created. Mind mapping (e.g., graphs, diagrams, etc.) helps to simplify thinking and learning while its efficiency is improving. Learning process of brain on writing that is the tool of communication, thinking system management, thinking

development, and remembering requires teacher not to force children but children should have some opportunities to write in order to reflect their perception on environment and anything related to tales, stories, and experiences. Presentation of children's writing through various methods is performed to show the benefits of writing. Practicing children to write with confidence, clarity, fluency, and writing plan, children must practice writing what they think on paper. They must practice to choose vocabularies to express their feeling, thinking, and imagination. Independent writing and story writing is designed to be integrated appropriately due to intention in enabling children to communicate what they think and associative thinking. Learning upon brain based learning principles is another foundation of learning process that is consistent with brain function method and it can respond to demands of students by considering on feeling, perception, experiences, skills and process of knowledge and thinking acquisition in order to create various works of learning.

After the economic crisis of 1997, Thai government had to adjust its role, duties, and missions in managing public affairs by mainly emphasizing on the achievement of the works with flow and flexibility based on social and economic conditions as well as technological advancement. Consequently, all parts of public sector had to adjust their roles and management by reducing the organizational size, number of personnel, and budget. As a result, personnel, especially educational personnel, had to be responsible for more work load. Performing their tasks with other organizations with the same goals was a part of world society requiring them to perform their duties with foreigners in different languages and cultures. These changes were the obstacles for achieving the goals. Since teachers were the important mechanism for passing on knowledge to students, enhancement of educational personnel and teachers' competency was very important, especially for solving the problem of lower level of students' intelligence. As a result, enhancement of teachers' competency on brain-based instructional management was able to solve such problem.

Brain-based instructional management was able to be performed by generating learning from 5 senses of human not only through teaching and knowledge transmitting. Those 5 senses were information acquisition and perception, knowledge obtained from senses, knowledge integration, integration of new information, news, and knowledge to link with experiences or link with existing knowledge for expanding or building new knowledge, application of knowledge in living or solving work problems. As a result, management for generating actual and permanent learning must consisted of 3 elements completely including knowledge perception, knowledge integration, and knowledge application for linking knowledge to practical action in living.

From such reason, the researcher was interested in enhancing the competency of primary teachers in brain-based instructional management and the results of this research would be guidelines and model for developing and improving instruction to be more efficient. In addition, if primary education was developed sustainably, extensively, and efficiently, it must give good effect to higher educational level for making students as the quality youths and quality citizens in the future.

## **2. Objectives**

- 1) To develop and find the efficiency of CBT Handbook of primary teachers on brain-based learning management.
- 2) To compare the competency of primary teachers on brain-based learning management before and after CBT process.
- 3) To compare the competency of primary teachers on brain-based learning management of the experimental group and control group.

## **3. Research Hypothesis**

- 1) The competency of primary teachers on brain-based learning management after training was higher than that before training.
- 2) The competency of primary teachers in the experimental group on brain-based learning management after training was higher than that of the control group.

## **4. Scope of Research**

### *4.1 The Experimental Group*

The experimental group of this research was consisted of 90 teachers who were teaching in Primary 4-6 level in Samut Songkram Province obtained from conducting cluster sampling in 2 Educational Service Area Offices divided into 15 schools per office and 3 teachers per school.

#### 4.2 The Control Group

The control group of this research was consisted of 90 teachers who were teaching in Primary 4-6 level in Samut Songkram Province obtained from conducting purposive sampling in the same schools of those in experimental group. However, these teachers did not pass Competency-Based Training on brain-based instructional management.

### 5. Conceptual Framework

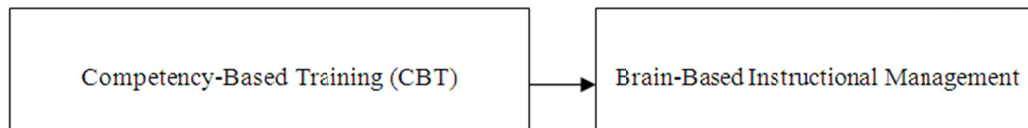


Figure 1. Conceptual framework

### 6. Definition

The brain based concept and theory is consisted of brain based concept principles, background, importance, and brain research results.

#### 6.1 Brain and Learning

During 10 years ago, from 1990, commuter innovation has been utilized for curing human's brain leading to research on brain's function.

Modern tools (including magnetic resonance tools or electro tools) can give several slides of function of brain parts per second enabling us to see function of brain parts clearly and inspect hormones in brain. These medical studies enable us to see brain's function that is very useful for learning, especially data collection called "memory" of brain. This helps to explain several questions that we are interested, for example, what we want to forget but we still remember, we sometimes can recognize someone's face but we are unable to remember his/her name, we can pay attention on reading and studying before taking an examination but we are unable to pay attention when we have no examination.

#### 6.2 Brain Elements

There are approximately one hundred billion brain cells (Sousa, 2001) that can be connected and work together in one billion circuits (10<sup>15</sup> or 1 with 15 zeros or 1,000,000,000,000,000) if brain cells are connected, they will be survive. On the other hand, if they are not connected, they will be dead. If they are connected with repeated using, they will be stronger with better ability of connection upon the number of use. This can be compared as the wide grassland, i.e., if it is connected from one point to another point as a shape with large number of passerby, such grassland will be larger with more clarity. If there is no passerby, it will be left without any benefit and finally disappeared. This kind of circuit plan is the way that brain keeps and records memory for long period.

Most parts of the brain called Limbic is consisted of function related to survival making students respond to environment immediately helping humans to survive and learn basic necessity as same as animals that can adjust themselves upon necessity in living. There are 3 important parts of brain including: thalamus that is the part for perceiving information through all senses and brain stem. Thalamus will help to check whether obtained information related to death or not. If so, body will be ordered to respond immediately, for example, we have to run if we see any tiger. The second part is amygdala helping to connect feeling with information. If we feel fear or feel that we are unable to do anything, brain will store this information in this part of brain without sending to the third part. The third part of limbic system is called hippocampus serving as the connector for delivering information to learning part or long-term memory. It will check whether learning information can be sensed with meaning or not. It can be sensed with meaning; learning will be performed and sent to be stored in long-term memory. If there is low mean with poor senses, it will be kept temporally or left, for example, we look at some telephone numbers for ordering food and we will not remember such telephone numbers after ordering, we look at some menus for ordering food and we cannot remember any menu after ordering. On the other hand, for complex knowledge, information will be sent to forebrain functioning on learning.

Forebrain is called cerebrum and cortex that is important for thinking, speaking, and playing the music. This forebrain is a part that we can see as a grey wave brain that is divided into two parts, i.e., left cerebral

hemisphere that has relationship with right side of our body and related to ordering, analysis, speaking language, mathematical operation, reasoning, and routine operation while right cerebral hemisphere is related to left side of the body and learning on overall picture, imagination, transforming language into gestures, complying with orders, enlightenment, and drama acting. However, there are some research results presenting that both sides of the brain are functioning together and if any side is damaged, another side will function in lieu of such side immediately. In normal condition, brain will function with a part of the brain as the main function.

Based on brain's function on memory, there are some important procedures, i.e., perception from senses including visual sense, auditory sense, gustatory sense, olfactory sense, and tactile sense, will be sent to thalamus that is next to brain stem. Thalamus will check whether it is the information related to death and survival or not. If so, it will be ordered to function immediately. In dangerous situations, brain is unable to think much but it has to take action immediately. This kind of function is similar with brain of general animals. We may see a buffalo that is being sent to the slaughterhouse learn to run away or even swim. We may see someone carries a refrigerator from a fire house or a gambler to jump across the fence for running away from the police. These kinds of action are unable to do in normal situations but this brain part will force humans and animals by releasing special hormone to enable humans and animals to survive. Thalamus will firstly screen information and if it is not related to death, it will be sent to amygdala. Do not forget that these brain functions can respond quickly in seconds until it seems to be automat operation. As a result, it is sometimes called instinct of survival. When information is sent to amygdala, this brain part will check feeling and respond to information with various kinds of feeling, for example, information leading to cheerfulness and sadness. This brain part will send information to long-term memory therefore we are able to remember events along with serious feeling properly. For example, person who wins the lottery will be able to remember such event for long period. Any person who survives from death can remember such event well as well. This brain part sends information to be recorded in long-term memory. On the other hand, if such information is not serious, amygdala will perceive such memory from old feeling. This procedure is very important for learning because if the brain tells that such information is used to give any bad feeling before (e.g., unable to do any work or fail to pass any examination), this brain part will stop such information not to be sent further or with bad feeling and no enjoyment to learn such information. Consequently, learning will have poor quality or will be limited as temporal learning. On the other hand, if former feeling is happiness and success, brain will be opened to receive information and learners will enjoy learning with interest making their perception better. Accordingly, learning with high quality is started from feeling presented by Goldman as EQ or passion in Dhamma principles. When learners are in good mood with happiness, liveliness, and safety, learners will learn new things better. As a result, teacher should not threaten students or tell students that what they are learning is difficult because this kind of words and information will lead to negative feeling for brain's function. Accordingly, new learning guidelines emphasize on positive measures or positive interaction in classroom and general working starts from mentioning positive thinking and information for sending to hippocampus. Information will be obtained for taking action started from translating information into two important things, i.e., touchable and sensible as well as meaningful to learner's life.

Translation of existing information will enable learners to have better senses and perception and if this information is useful for them, they will be able to improve their life quality by such information.

According to the study on Brain Based Learning (BBL), it can be seen that brain can store knowledge and memory in long-term when existing knowledge is reviewed and connected with new knowledge enabling learners to have broader learning. Learning management through cooperative group by using mind map and games is another important learning management considering on brain of learners giving long-term knowledge and memory due to activities with review of existing knowledge, presentation, and repetition for building long knowledge and memory.

### *6.3 Principles of Brain Based Learning*

- 1) Brain is the processor that is working in parallel requiring various kinds of learning in order to make children pay attention on what they are learning.
- 2) Learning must be based on the function of all body system, i.e., emotional control, amusement building, nutrition, exercise, and relaxation that is important for learning.
- 3) Humans have demand to find meaning since they were born, i.e., building challenge and learning with questions.
- 4) Human's meaning finding is considered as a format activity, i.e., learning requires format, system, and understanding by emphasizing on application or exemplification, or comparison.

- 5) Emotion is important for format working, i.e., emphasizing on feeling and understanding in order to understand that each child is different.
- 6) Brain processes information wholly and partially at the same time, i.e., partial understanding emphasizes on connection between learning and real life in order to make such knowledge useful.
- 7) Learning relies on paying attention to anything and perception on nearby environment, i.e., environment that is consistent and suitable with learning topics making children to learn better.
- 8) Occurred learning relates to perception processes while being conscious or unconscious, i.e., good learning should leave some questions for further thinking of students.
- 9) We have at least two methods to manage remembering and remembering is another process of learning but another remembering method is remembering with format and motivating children to be fun with remembering or perceiving disadvantages of inability of remembering. Consequently, children will be able to utilize such knowledge immediately.
- 10) We can understand easily and remember accurately when such thing or skill is in natural remembering system that is related to us. Therefore, learning must be consistent with daily life activities or existing things in environment. Field trips, children's story telling, and society can be used as the drive for creating learning.
- 11) Complex learning will be stimulated by challenge and restraint. Learning should give some opportunities to children to try and practice upon their thinking.
- 12) Brain of each person has specific characteristic, i.e., children should have alternatives in the fields they want to learn and they should be supported fully with improvement of poor skills to be in normal standard.

#### *6.4 Foundation of Brain Based Learning*

Motivating children to be alert with relaxation is building the atmosphere preventing children from being pressured but they will be challenged to find answers.

Making children to pay attention on the same thing is using various kinds of media as well as raising actual events as the examples for connection and explanation with knowledge obtained by children.

Making children to obtain knowledge from their own actions is making children to do experiment, invent, or tell actual related experiences from principles and foundation of Brain Based Learning (BBL) that can be used in Student Based Learning activities emphasizing on activities leading to long-term learning developing brain to have long-term memory. This will be beneficial for learning in higher levels.

#### *6.5 Brain Based Research Results*

The ultimate desire of mind is determining its own direction. The foundation demands of human are independency, decision making, and the highest ability level of themselves therefore learning management must respond to the ultimate desire and learning can be occurred when the learning activities have the following characteristics:

- 1) Students must be able to choose and make decision by themselves as well as able to use their own learning methods. Consequently, the best curriculum of the world is the curriculum that can be determined by students because their satisfaction will be in high level. This kind of learning management is the best way to meet with brain's function. However, teacher must have some important techniques to challenge students to learn more under the direction that is useful for the world and society.
- 2) Students must evaluate themselves mainly in order to obtain the good concept enabling students to see their real abilities. Accordingly, assignment must use quality dimension as the principle in explaining which assignment should have which answer, quality, and score. This is the way to connect score to the meaning of score in all procedures of evaluation. When the quality dimension is clear, students are able to judge their own scores and it also stimulates students to improve their own skills. Students are able to see guidelines clearly and know what they should practice more to increase their scores.
- 3) Students utilize existing knowledge and methods to improve learning with the highest meaning, i.e., learning that is consistent with existing knowledge. Connected learning requires existing information and thinking method as the beginning in order to connect with new information in order to obtain new knowledge and methods leading to better learning. Learning can be occurred in students and connection of the students' brains leads to necessity of the use of existing information for building new knowledge and methods with higher quality. This kind of learning is called that students are the persons who build

knowledge.

- 4) Students find their own methods and exchange with one another. Good learning is the way that students find which ability they have and whether it is the real ability. Importantly, they can find the best learning style of themselves. Learning style is the method of thinking and perception of media on demands for such development. Each student must know himself/herself how he/she thinks and which type of media he/she perceives before exchanging with other persons in order to obtain mutual learning. This kind of thinking is the way that students and teacher find learning style of each student enabling teachers to choose instructional media and presentation to meet with limitations of each student. Consequently, learning will be better.
- 5) Students must practice learning methods. To develop children with limited abilities or learning disability, teacher must gradually practices students to perform each procedure without skipping any procedure because weak children are unable to create their own learning method. On the other hand, smart children can create their own learning methods, teachers are required to help weak children to have their own learning methods that must be gradually operated and consistent with learning style as mentioned before. Weak children need actions and senses with clear procedures in order to obtain good learning.

Brain has specific characteristics that are different from other brains but it has the same level of importance. Based on the brain research, it was found that brain has been developed from existing thing called heredity while thing affects to brain is called environment. When combining these two things, it is called the result for brain development. Brain's function is different from each person even twins. However, humans' brains are accepted equally upon the Principle of Equality therefore teacher must reward each student in each dimension equally. Consequently, teacher is required to study and make understanding on multiple intelligence and manage learning to reward multi intelligence by developing brain of each student to meet with their own direction. When teacher has already learned that students have tendency or intellectual cost in any field, teacher will develop each student upon such cost and tendency to obtain higher ability and knowledge. Development of brain to meet the ultimate ability can be performed by practicing brain in various kinds and levels through taking actions and solving problems. Brain can be developed properly when it is challenged properly with perception of results meaningfully. Brain challenge can be performed by practicing brain to solve problems and think complexly in various perspectives or making the meaningful projects allowing students to find problems, design, think, and take actions by themselves. This will make them think, analyze, synthesize, and solve problems by themselves started from finding problems to choose priority of alternatives on decision making, and actual action. Perception of the results of such action must meet with assignments and indicate guidelines for improvement for actual utilization. Accordingly, evaluation during instruction and activities is more valuable than post-evaluation.

Emotion is important for all learning procedures because emotion is related to learning started from information perception. Accordingly, building positive emotion to students is very important for learning from the start that is begun with motivating to build interest to reward for obtained results, admiration, the joy of success, and promotion of further interest and learning.

Teacher must use positive words and practice to accept students without any condition in order to make them feel that they can learn properly and challenge them to improve such learning by using leading questions. During assignments, teacher should be close to students in order to build confidence and teacher must touch students sometimes in order to show support and morale even play with students for relaxation and familiarity. Teacher must express confidence that students can learn what he/she is teaching certainly.

Teachers should increase responsibilities of students in choosing during instruction. Teacher must gradually responsibilities of students while teaching by allowing them to make their own decisions, evaluate themselves, design their own solution, and responsibilities on learning. Students must be able to choose lessons and learning methods by themselves while teachers always give them alternatives in order to allow them to define their own responsibilities, criticize themselves, and find solutions to improve their learning. Consequently, students will feel ownership making them pay attention on and attach to what they are learning leading to attention and better grades.

teacher must improve the joy of success of students, i.e., good learning must lead students to reach the goals and it is necessary for teacher to make students achieve with learning in order to give them positive emotion and admiration to their success. Teacher must start from what students can do and gradually increase level of difficulty upon students' levels in order to enable them to answer correctly. Accordingly, students will pay much attention on learning and have interest for further learning. The more teachers make students to sense the joy of success, the more they prefer learning on such topic.

Learning process and learning style is the method leading to knowledge. Since learning emphasizes on process equally to correct answers, it is not proper to give score to correct answers only. Learning methods, learning process, and learning styles are various therefore teacher should take action upon the guidelines of brain development.

Since wrong answers are the beginning of learning, students' wrong answers are considered as the opportunities of teacher to perform instruction by analyzing the cause of such incorrectness. Teacher can start from using questions or positively wrong answers then giving some opportunities to students to explain their answers leading to development of the use of information in other perspectives.

Brain looks for learning patterns and can remember well. Learning that is occurred when brain can find patterns started from the same group are called in educational term as concept. The ultimate pattern is conclusion as the principles, criteria, and theories. This kind of knowledge must be the pattern that is created by brain and data obtained from brain for creating patterns lead to meaning. Subsequently, brain can remember such information and knowledge in long period that can be used immediately. This kind of pattern building includes mind map, diagrams, and graphs. Students should practice using this pattern building for presenting until they are skillful then these diagrams, graphs, and mind map will be fostered in their brains and they can use these things with all contents. This represents that their brains have thinking patterns that can be used for building quality dimension in learning and evaluation.

Everything must always be reviewed and inspected. Reviewing and inspection is performed in order to conclude that which the causes of success are as well as the causes of advantages and disadvantages. This activity must be performed in every successful work in order to improve and learn from mistakes or success. This principle is called scrutiny or the last activity that must be performed regularly in all works.

The best and the easiest learning is actual action. According to the results of brain researches, it was found that learning requires the use of all body parts including body, brain, and emotion for leading to good learning. The best knowledge is knowledge that can be used for improving existing knowledge therefore knowledge is obtained from action practice and action for remembering in long-term memory. Touchable and sensible knowledge is meaningful for brain leading to long-term memory. This kind of learning enables students to know themselves while sympathizing and understanding other persons leading to mutual development as said by the King of Thailand or the Principle of Understanding, Accessibility, and Development.

Multi knowledge and perspectives can be mutually utilized leading to better brain development. When students can see various perspectives, it will help to develop learning, thinking, and operation in the same direction including integrated curriculum management, integrated instruction, discussion, learning exchange, and sympathy on other people. Accordingly, it is considered as the main activity in expanding knowledge leading to mutual development.

## **7. Research Process**

- 1) The experimental group of this research was consisted of 90 teachers who were teaching in Primary 4-6 level in Samut Songkram Province obtained from conducting cluster sampling in 2 Educational Service Area Offices divided into 15 schools per office and 3 teachers per school.
- 2) Documents and researches related CBT and brain-based instructional management were studied. Subsequently, the training course was created upon such process then teacher's brain-based learning management test was created as 60 items of multiple choices test and 2 items of subjective test (Multiple choices test was created for testing teachers' knowledge and understanding while subjective test was created for making teachers to write instructional plan and design brain-based instruction).
- 3) The developed training course based on CBT process and test must be inspected by 5 experts before improving upon their suggestions.
- 4) Improved training course based on CBT process was tried out with teachers who were not the target group in order to find its efficiency through try out and to find the Confidence Interval of the test.
- 5) The test must be tested with teachers in the experimental group and the control group before starting training.
- 6) Target teachers passed Competency-Based Training CBT).
- 7) After training, Multiple Intelligences Tests were taken by teachers in experimental group and control group.
- 8) The test result was inspected and the obtained scores were analyzed by using two sample T-test (Independent-Samples).

## 8. Conclusion

The results of development of CBT curriculum of Primary Teachers on Brain-Based Learning Management were as follows:

Part 1: The results of development of CBT curriculum of primary teachers on brain-based learning management

1) The results of development of CBT curriculum of primary teachers on brain-based learning management in order to reinforce CBT competency of primary teachers based on the Theory of curriculum development were setting curriculum's objectives and learning objectives, specifying curriculum's contents, ordering contents and specifying duration, selecting experiences, ordering experiences, holding the training, specifying evaluation and evaluation methods.

2) From the results of evaluation of experts on the efficiency of CBT curriculum implementation of primary teachers on brain-based learning management, it was found that, in overall, the efficiency of curriculum implementation was in the highest level. When considering on each aspect, it was found that contents had the highest quality followed by training duration, evaluation, supporting documents, curriculum objectives, curriculum structure, and training media was in the highest level followed by training activities and principles that were in high level, respectively.

Part 2: Comparison of primary teachers' competency on brain-based learning management before and after CBT process

Table 1. Table of pre-test and post-test scores and t-value

Test	$\bar{X}$	S.D.	t
Pre-Test	33.49	0.66	58.01
Post-Test	49.47	0.64	

From Table 1, it was found that the sample group of 90 students had to do this test with 60 items and their average pre-test score was 33.49 with Standard Deviation of 0.66 that was considered as moderate level. Their post-test score was 49.47 with Standard Deviation of 0.64 that was considered as high level and t was 58.01. The pre-test score was higher than posttest score with statistical significance of .05.

Part 3: Comparison between Competency of Primary Teachers on Brain-Based Instructional Management of the Experimental Group and Control Group

Table 2. Table of test scores of experimental group–control group and t value

Test	$\bar{X}$	S.D.	t
Control Group	42.80	0.75	47.98
Experimental Group	49.47	0.64	

From Table 2, it was found that 90 students of experimental group and 90 students of control group made the correct answers of 60 items and the average score of the experimental group was 42.80 with Standard Deviation of 0.75 considered as high level. The average score of control group was 49.47 with Standard Deviation of 0.64 considered as high level and t was 47.98. The score of the experimental group was higher than that of control group with statistical significance of .05.

## 9. Discussion

The development of CBT course for primary teachers on brain-based instructional management based on the Theory of Curriculum Development was consisted of setting the objectives of curriculum and learning objectives, determining the curriculum contents, ordering contents, specifying duration, electing experiences, ordering experiences, holding training, and determining what to be evaluated and methods of evaluation. This was consisted with the research of (Taba, 1972) who presented the procedures of curriculum development as follows: (1) deciding demands; (2) setting learning objectives as demanded by society; (3) selecting contents for teaching in order to generate leaning that met with social necessity; (4) ordering procedures, improving and amending selected contents; (5) selecting learning experiences that would be added to contents and process that was



consisted with objectives; (6) ordering procedures, amending and improving learning experiences; and (7) evaluating implementation of curriculum. In addition, the results of this research were also consistent with those of the research conducted by (Utranant, 1994) who presented the procedures of curriculum development as follows: (1) analyzing basic data; (2) setting objectives; (3) selecting and ordering contents; (4) determining evaluation and test criteria; (5) implementing curriculum; (6) evaluating the use of curriculum; and (7) improving curriculum.

From evaluation of experts on the efficiency of implementation of CBT curriculum for primary teachers on brain-based instructional management, in overall, it was found that the curriculum was efficient on implementation in the highest level. In addition, it was also found that such result was consistent with that of (Taba, 1972) stated that the curriculum was consisted of 4 elements including: general objectives and specific objectives, contents and class hours of each subject, instructional process, and evaluation project based on curriculum. Moreover, this result was also consistent with that of (Khunakorn, 1995) who divided elements of curriculum into 5 elements including: general objectives and specific objectives, contents and class hours of each subject, instructional process, evaluation project based on curriculum, and curriculum improvement.

From comparing the competency of primary teachers on brain-based instructional management before and after CBT process,  $t$  was 58.01 and the post-test score was higher than that of pre-test with statistical significance of .05. From comparing the competency of primary teachers on brain-based instructional management of the experimental group and the control group,  $t$  was 47.98 and the score of the experimental group was higher than that of the control group with statistical significance of .05. This result was consistent with that of (Waree & Petcharaporn, 2013) who studied on Research has shown that: 1). the ability of teaching and learning according to the theory of multiple intelligences after training is higher than before training significantly in statistic at .01 level, 2). The satisfaction of students to the training courses was overall at the highest level.

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