Chapter 2
Review of Related Literature

This research reviews and summarizes the literature for the concepts in the following topics.

1. Concept and Theory of Thinking

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1. Concept and Theory of Thinking

1.1 Definition, scope of the study, type and factor influencing the thinking skills.

Thinking is a functional process of the human brain to use the cognitive experience and stimuli to analyse, compare, synthesize and evaluate systematically and logically to reach proper solutions to problems or a new creative invention (Ministry of Education, 1999: 3). This concept is consistent with the belief that thinking is the

functioning process of the human brains, which are divided into the right and left sides, as the marker of personal abilities (Ministy of Education, 2005: 9). Beside this definition, Bruner and others (1956: 233) perceive that thinking is the process that can be used in conceptualization through classifying of the differences, categorizing of the groups and identifying names about facts; and thinking is the process to interpret data and summarize the references through remembered details. This proces connects the derived data and the brought out criteria to be used logically and appropriately (Bruner and others, 1956: 233). In addition, Royal Institute Dictionary B.E 2525 identifies that thinking is showing its existence in some forms or stories in the minds. Guilford (1967: 13) argued that thinking is seeking the principles in classifying all the things or the facts, analyzing them to get the summary of the truely principles, and bringing those principles to different situations. Krulik and Rudnick (1993: 1) propose that thinking is a set of abilities to get into the right summary from the range of identified information. The children, for example, must create thoughts about the abstract forms of the perceptible relationships in some problematic situations. Then they proceed to check any possible corrections for their previous thoughts and then explain to confirm the end summary. Then this summary is included as part of the form of new line of thought.

From the above concept, it can be summarized that thinking is a set of abilities or skills that include the human brain's functional processes. There must be also stimuli to provoke human mind and the brain to process the inputs, data, or knowledge to find efficient methods to solve or reduce the problems.

About studying the scopes of thinking, the Office of National Education Commission (2001: 19-20) has identified the scopes of thinking into two main groups, which are the Thinking Skill Group and Thinking Process Group. The details are given as the followings:

1. Thinking Skill is the ability to express the processes of thought skillfully. Each individual naturally has different thinking skill levels. Some individuals can think fast and in logical steps in short succession of time while the others think rather slowly and make some mistakes out of confusions. Nevertheless the thinking skill can be properly trained and developed. Any person who gets appropriate training can become

competent thinker with heightened thinking skills. The thinking skills are composed of seeing, observing, comparing, classifying, clarifying, interpretating and summarizing the inputs or information.

2. Thinking Characteristics are the forms of thought, which are divided into two types, e.g. *purposeless thinking* or thinking aimlessly without clear objectives and *purposeful thinking* or thinking usefully with a better quality of thought compared to the earlier kind of thinking. The decent thinkers have objectives to plan, to solve problems and to find guidelines to achieve something meaningful. This kind of thinking decency is very important because if thinking is utilized in ignorant way, it will merely create damages or troubles. Therefore, the aim to develop the students' sufficient capacities to think properly is ver important.

3. Thinking Processes are the complicated thinking processes that require some basics in many aspects mixed together. This thinking process has certain steps in order to find solution for the problem and the answer or the summary of the thought. Therefore the thinking process is a High-Order thinking skill.

When studying the definition of thinking characteristice, it has been shown that many international scholars also study the thinking characteristics, such as Wallach and Kagan (1956: 105). These scholars use the Conceptual Style Test, which are designed in black and white line. Each item contains three pictures and the tested persons are asked to pick two pictures that they think match or related to each other. Then these samples give the reason for their choices. The pattern of this reasoning tends to reveal the thinking processes of the persons taking the Conceptual Style Test. Furthermore, Kagan divides the thinking characteristics into three types, which are the Descriptive-Analytic Style, the Relation Style and the Categorical Inferential Style. Later this division is expanded to capture further division of the thinking patterns into five types as the followings.

Type 1 (Analytic Style) is the categorizing the reaction to the type of stimuli according to their similar responsive characteristics. For example, if a person is facing a series of stimuli in form of the pictures of a chair, a table, and a vase, the person who has this type of thinking tends to select the pictures of a chair and match it to the picture of a table by reasoning that both of these objects are made of wood.

Type 2 (Descriptive Style) is reacting based on the type of stimuli especially the physical whole characteristics of the stimuli. For example, the person with descriptive style is impressed by the description of the picture in terms of object, manners, appearance (a person, animal, or object which appear as the stimuli) such that if the person in presented with three pictures (a table, chair, vase like the example above), the person tends to select the pictures a chair and a table. The person would offer a reason that both of them have four legs.

Type 3 (Categorical Style) is the thinking that categorizes a stimulus into categories by using experience or the derived knowledge from making a decision. It is the judgment without thinking or considering about the similarities on the forms but with considering certain common qualifications. Like the example with the three pictures as above, the person who has this type of thinking would select to match the chair and the table with a reason that they both are utensils for use.

Type 4 (Inferential Style) is the thinking to categorize the types of stimuli into categories according to the emotional characters of the stimuli. For example, if confronted with the stimuli such as the pictures of a chair, a table, and a vase, the person with this kind of thinking would select to match the chair and the table with the reason that they can be used to place something on them.

Type 5 (Relational Style) is the thinking to arranging the type of stimuli by finding the relationship of the set of stimuli to one another by considering on duties on or the relationship between the stimuli. If confronted with the stimuli of the pictures of chair, table and vase, the person with this type of thinking tends to select to match the table and the vase with the reason that the vase must be placed on the table (Nuanpen Kosolsert, 1964, cited in Chavalee Upaphai, 1980: 13-15).

Related to the factors influencing the thinking skills in human beings, in general each person has different characterisitics when expressing or revealing their patterns of their thoughts to solve problems. Some persons can think fast, correctly and in clear order while others think slowly with mistakes. Ausubel (1968: 581) argued that there are three components that differentiate people when they solve problems. These components are (1) the person's knowledge about the contents of the learned subjects and their levels of familiarity with the subjects, (2) the ability to think to solve

problem and general knowledge on the methods to solve the problems efficiently, and 3) the personal qualities such as emotional security, drives and anxieties. Besides, the Office of National Education Commission (2001: 17-20) has identified that the thinking skills of each person are depended on several relevants factors such as family background, background of knowledge, experience of life, brain function, culture, morality, perception, the living environment, learning potentials and psycho-motoric sensory development.

One of the studies on the capability on thinking and cognitive development done by Donna Crawford and Richard Bodine (1996 cited in Kamonphan Chivaphansri: 68-71) proposes that the children within the age range between 12 and 14 are capable of solving the critical problems, foreseeing the consequences in short- and long-term periods, showing creativity, identifying the outer standard in order to sense justice such as promulgated in the standard laws-rules and regulations of the school-and evaluating the needs and then solving the problem; they are all aware of the efficiency of the social contracts with others in solving problems related to justice and truth. About their capability to think creatively, these children can participate in the new projects with their peers or adults, or can follow the training to think creatively with the friends who have conflicts with each other. They can understand the interaction of all things and can create new thoughts. These teenagers can also learn to think more creatively. In terms of their capacities in making decision, these children can usually manage to summarize the problems occurring in the classrooms.

The scholars also analyze about the factors that affect the processes of human thought. The scholars conclude that the outer environmental factors and the inner personal factors are the equally important to build the persons' different levels of capability to think. In addition, there is a study on the brain functioning process that reveals the importance of the brain functioning to the thinking development of people in different age ranges. The results of studies on the development of the children capability at Mathayom Suksa 2 level (at the age range of 12 to 14) show that these children can foresee what is possible by considering the consequences, show creativity, and act with self-confidence. Besides they can also think creatively to create a new project for others. About making decision, the children at this age range can

assist the problem-solving for the common problems in their classrooms. Therefore, the design of the activity to train the thought for the students at Mathayom Suksa 2 (aged between 12 and 14) can take many forms, e.g. news, events, general knowledge for children to train their analytical mind, to synthesize data or abstract concepts, and to solve the problems through learning in the project work according to their own opinion and with the group work with other people.

1.2 Guidelines in developing the thinking capability

Thinking has shown characteristics both as the processes and the abilities. Taba said that thinking is learned and thinking can develop the learning (1965 cited in Boonchu Chalasathien, 1996: 21). For the methods to develop the thinking skills of a person, the experts usually advise the methods as the followings.

Schiever has proposed the concepts, which are consistent with those of Taba who insisted that thinking is something that can be trained (Schiever, 1991: 138). Valett (1978: 27) also concludeds that a person can learn to develop one's thinking skills (Cognitive Skills) and their thinking abilities (thinking processes). In addition, the Cognitive Skills and the Thinking Processes follow different development plans and thus require appropriate time and order for their development to the highest level. Furthermore, Schiever believes that a person can learn to think with different methods, and the development or revision of flawed thinking skills are built through each individual's personality and training for a long time. The children who learn to think well will rely directly on the teaching projects on specific time and the educators' attempts that put their work on the projects.

Piaget (Valett, 1978: 33; citing Inhelder and Piaget, 1958) explains about the growth and the development of thought in several main steps. The thinking structure appears naturally in the children. In a series of progressive steps of the development, the thinking skill and the ability to solve more complicated problems grow. Therefore the understanding on the type, style, thinking development and structure, and the logical capability can lead to understanding about the process of development of the efficient thinking.

The concepts offered by Krulik and Rudnick (1993: 8) reveal the methods to train to analyze the problems, propose the solutions, face the problems, finnd the

challenges in interesting problems, all of which offer the chances for the learners experiences to find the right answers by themselves.

Sternberg (1985: 85) proposes Triarchic Theory which aims to analyze the growth of cognitive ability and capability in human beings. Later Sternberg finds that the things which drive human to achieve in their lives are the intellect composed of analytical thinking, creative thinking and the application. He proposes the concept of enhancing the children's potential to think properly in four skills. The teachers should allow the students to train the important skills such as recognizing "who did what," "when", "where" and "how". The training of these skills allow the learners to analyze, compare, evaluate, judge and then to practice the creative thinking, creative imagining, mimicking or creating. Proper Training can turn the knowledge into illustrative practices.

From these concepts, Sternberg (1998: 65-72) proposed 12 teaching principles as the followings.

1. The target of teaching is to create the competent students with sufficient foundation of knowledge, flexibility and abilities to practice their knowledge when needed.

2. The teaching should cover the analytical skills, the creative thinking and the knowledge application. Motivating the students is not limited to only analysis of the information, comparison of the similarities and differences, or evaluation and explanation of the events. It is not a training emphasized on only memorizing. The teaching to enhance the students' creative thinking skill is to motivate them to create, design, imagine and role-play. In this training the students are motivated to apply their acquired knowledge into practice.

3. The evaluation should cover the analytical skills, creative thinking and capacity of knowledge application beyond the memorized skills.

4.The teaching and the evaluation should allow students to show their full potential, capability, and strong points. It not only helps developing the learning characteristics of the students but also increases their self-confidence.

5. Teaching and evaluation should help the students to improve their weaknesses. This should be taught in groups and in person to cover three skills, which

are the analytical skill, the creative thinking and the knowledge application. The teachers help the student to spot their strengths and to improve their weaknesses simultaneously.

6. Teaching and evaluation should include the capability to practice the learned thinking processes in the real life (the High-Order Thinking Skill) to solve problems. The problem-solving has seven steps which are 1) the identification of the problem, 2) the identification and the defining of the problem, 3) the identification of the strategy to solve problems, 4) the identification of the characteristic of the things thought in mind and the preparation to express them in data forms and gathered problem, 5) the identification of the resources used for solving problem, 6) the supervision and the caring of the problem solution, and 7) the evaluation the problem solution.

7. Teaching should cover all practical components, which are 1) entering the code, 2) giving opinion, 3) creating diagrams, 4) applying (application), 5) comparing various alternatives, and 6) showing responses. These components are beyond the ordinary teaching for the students to in the known practical components. However, the indispensable part is the coordination between these components and the use of the Higher-Order Thinking process.

8. The teaching should cover the components on seeking for knowledge such as 1) enter the code (encoding), 2) select the comparison model, 3) select and gather relevant data. For example, the teachers may ask the students to find the meanings of unknown words after they read its context.

9. The teaching and evaluation should be various in their presentation and should also cover the use of language, numbers, and pictures as well as data interpretable through observation, listening and expression in written and spoken forms.

10. The important thing in teaching is the learning that connects the learned abilities to the inventive problem-solving. This connection not only increases the foundation of knowledge but also develops the students' thinking skills because of the challenging materials used in learning. At the same time, the students practice well to process the data until they can do it automatically.

11. The teaching must be able to help the students to adjust themselves to the environment and select the environment. The students are expected to be able to adapt to the environment. For example, the students can adjust their behavior to the teaching of certain teachers, select the activities, choose topics of their reports, decide the projects and titles of the portfolios, select the learning programs, select the main course and class levels, and join the clubs or activities or special curriculum.

12. Teaching and good evaluation should see the whole picture of the intellectual activities more than parts because each of the components is inter-related to one another. Thinking creates the relationships among tasks or situations and provokes the ability to process the arrays of information automatically. Finally the application will lead to the experiences to adapt, adjust and select the environment because it requires many skills in different milieus. Therefore the teaching and evaluation of the student's achievements should be done simultaneously.

The understanding of the above data can lead the teachers to design the learning activities to enhance the proper thinking skills to the learners by good preparation and research by the teachers who are consequently confident about the learners' development in the thinking skills. The concepts of Taba (1971), Schiever (1991) and Valett (1987) have confirmed that that thinking skills are the skills that anyone can learn and develop. The teachers who achieve success in training the thinking skills must spread their knowledge to other teachers that the latter would understand the type, structure and development of the thinking skills and develop the thinking skills efficiently (Piaget, 1958). In addition, arranging the thinking skill activities must be done continuously and emphatic on the training to solve the problems according to the identified situation twice a week. This model of continuous training is consistent with the concept of Krulik and Rudnick (1993) who propose that the teaching of the thinking skills must be continuous and emphatic on solving the problems, using the logics in the classroom and practicing the Sternberg's (1998) 12 teaching techniques. Sternberg (1998) emphasized on the teaching targets, the teaching of guidelines and evaluation with sufficient coverage, and the variability of learning to efficiently develop the thinking skills.

1.3. Analytical thinking, Synthesis-type thinking, Critical thinking, Creative thinking and Metacognitive thinking

The research on the thinking development needs to study the definition, component, behavior process and thinking skill enhancement in order to design the training activity for the thinking skills among the students. The details are as followings.

1.3.1 The Analytical Thinking

Analytical thinking is the systematized collection of data to increase the level of understanding and to identify the effective angle of analysis through knowledge and experience. This thinking covers the discovery of the shared characteristics in groups of data, the comparison between the variegated information from different groups, and the results' positive and negative aspects. The analytical thinking utilizes the logics, the continuity and the order (Tisana Khammanee et al, 2001: 133). Kriengsak Charoenwongsak (2003: 24) stated that the capability in classifying the components of a thing or an issue and then finding the causal relationships among the components is similar to the Ministry of Education's policy (2005: 52). Ministry of Education has identified that the classification of an array of data into components and the arrangement of the structural relationship of all components are important to build knowledge, to understand the causes and consequences of events, to solve problems, to evaluate data, and to decide the creation of new inventions or ideas.

For the components on analytical thinking, Ministry of Education (2005: 25) proposes that the analytical thinking requires the capacities such as 1) interpretation, understanding and giving reason to the things to analyze and interpret, 2) knowledge and understanding of what to analyze, 3) observation skills, curiosity, inquiring mind, discussion through questions related to analysis based on 5 W 1H (Who, What, Where, When, Why and How), 4) finding the causal relationships between the causes and the consequences and all relevant factors. When the events happened, or what were the impacts? What were the components that led to such consequences? What are the steps to re-create the events? What methods to solve the problems? If certain solutions are tried, what would happen in the future? If the event

was arranged in certain way, how did it proceed? How certain factors are related to what has happened?

In the training process of analytical thinking, some scholars classify the process of analytical thinking into five steps (Kriengsak Charoenwongsak, 2003: 12-22) e.g. the interpretation or understanding of the data, the setting of connections for the chain of events (the truth), and the evaluation of all factors to make decision, and the classification of the components to perceive the whole picture of event or issues. According to Ministry of Education, the analytical thinking proceeds in six steps, e.g. the study on the data or the event to analyze, the identification of the objectives or targets of analysis, the classification of the details of components to analyze, the arrangement of the structure or relationship between the important and less important components, the presentation the analyzed data, and the application of the analysis results for practical use (Ministry of Education, 2005: 53).

From the study of the guidelines to promote the analytical thinking, Kriengsak Charoenwongsak (2003: 97-100) identifies that the analytical thinking seeks the answers to the questions provoked by the learner's curiosity. When one learner gets intrigued by something, one wants to understand it in all angles that it is clearly explained, evaluated, solved, and useful for decision-making. Therefore, setting up a series of analytical questions is very important. The questions should be related to the classification of components and the seeking for the causal relationships between the issues under analysis and the other relevant issues. The technique of 5 W's 1 H (Who, What, Where, When, Why, and How) is a helpful technique to find the truth about that issues in all angles beyond the obvious ones. The detailed and various questions for the analysis purposes are sometimes not necessary because the simple questions with clear objectives and sufficient coverage over the issues one wants to understand are good enough. Setting up these efficient questions is different from setting up the objectives of analysis as the followings.

1. The Human Analysis is setting up the questions that lead to the clarification about who related to whom, when the event happened, where, how it happened, why it turned out like that, when it happened, what were the impacts and how the causes produced the consequence.

2. The SWOT Analysis is setting up the questions that reveal the facts in terms of who did what, where, when, how and why?

Beside using the technique of 5 W's 1 H, the curious learners can also question the conditions, the numbers or frequencies of the events, the priority and comparative (e.g. 'if this event doesn't happen, then who will?' or if … then), the number or frequencies of the perpetrators and events, etc. The learners can also question about the closest actors to the perpetrators, the most important (or the next second important and the least important), the main issues (the second main issues or priority), or the likelihood of one event to happen compared to the others (comparative). Similar to this concept, Ministry of Education (2000: 204) already identified that the setting up of the analytical questions should identify the situation or issue to which the students are familiar (but never discussed in the classroom before) and whose components or arranged principles can be analyzed. Therefore the questions should allow the students to compare the similarities and differences among the events' components.

The studies of behavior identifying the students' capability in analytical thinking show that the students' abilities for the analytical thinking can be observed and evaluated by the teachers. These observations are possible from the students' action in 1) the classification of the components of the events under analysis, 2) the classification of the details of components of the events under analysis, 3) the arrangement for the creation of the relationship between the important and accessory components, and 4) the presentation of the analyzed information in easily understood forms (Ministry of Education, 2005**:** 5).

In conclusion, the analytical thinking skill is the capability to classify the components of an event or an issue and to link the important and the accessory components, in order to search for the causes of the event or the identified thing. The components of analytical thinking are set by the students' capability to interpret the meaning of the identified event, their knowledge in the principle or criteria for analysis, and their searching for the truth or the importance in order to make conclusions related to the events. For the training procedures for the analytical thinking, some thinkers propose different concepts in details but these concepts share

similar steps. These shared steps are the study of the data or the event to be analyzed, the identification of the objectives of the analysis, the classification of the details in the event to analyze, the study of the relationship between the important and less important components, the presentation of the data, and the application of the analyzed data to real life, to promote the learners with the analytical abilities, the teachers must train them to set up the analytical questions by using the technique of 5 W's 1 H to search for the facts related to the issues, things, or events.

From the studies shown above, this study can design the training activities for the thinking skill development, select the challenging issues for the students' discussions, and set up the questions—from the teachers or the students—for the activities to incite the learners' interests and curiosity. The training to set up the analytical questions within the activities will limit the scope the questions on the classification of the event's components, the casual relationships between the analyzed issue and other relevant issues, and the use of the technique of 5 W's 1 H (Who, What, Where, When, Why, and How) to lead the students toward the analytical thinking and the search for the truth about certain events.

1.3.2 Synthesis-type Thinking

The synthesis-type thinking means the capability to gather more than two things together to create a new one with distinctive characters, structures and functions from each of the combined things (Luan and Angkana Saiyos, 2000: 155). Chawan Paratkul (1977: 324) stated that the capability to integrate the stories or issues, as well as to set the importance of their contents in order to produce a new thing, is similar the capability to conclude or to set an ending through the use of various types of knowledge that already learned.

The characters of the analytical thinking are identified and classified by Chawan Paratkul (1977: 324 -367) who classifies the analytical thinking into three types as the followings.

1. Synthesis of the Statement (Production of Unique Communication) or bringing the knowledge and experience to mix together in order to create the statement or new action that enables the dissemination of the thoughts and emotions

between the communicators and others through description, poetry, drawing or musical instruments.

2. Synthesis of the Plan (Production of plan and proposed set of operation) is the earlier identification of the guidelines and the steps to implement to implement the business or the activities smoothly and successfully to achieve the identified criteria and standards.

2. Synthesis of the Relationship (Derivation of a set of abstract relations) is the attempt to bring the rank of importance and principles to integrate into one story of united issue and to create a new proposition related to a previously unknown relationship.

Ministry of Education(2005: 61) classified or categorized the synthesis-type thinking into only two types, which are consistent with concept of Kriengsak Charoenwongsak, as the followings.

1. Synthesis of thinking is done in order to create new things, such as the creation of certain equipment as necessary.

2. Synthesis of thinking is done in order to create a new concept, which is the development and experiment to invent a new concept. If the students can synthesize well, they can invent new concepts or things, which can be useful for the society.

The process to train for the synthesis thinking is preferably done in the intermittent manner. The principles for the synthesis thinking training has been identified Kriengsak Charoenwongsak (2003: 41-75) as the followings.

Synthesis-type Thinking Steps to Create a New Thing

1. The principle of imagination and creativity. One of the best trainings of synthesis thinking is undertaken through the use of imagination in the creative thinking. The students are trained to integrate things that have no apparent relationship to one another and connect them together to be a new thing that can be used.

2. The principle of synthesis of the component.This technique starts from setting up the objectives (what to synthesize, in what issues). After that the synthesizers list the characters that are related to one angle of the events or things the synthesizers analyze. And then they list of characters related the other angle of the

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events or things. These lists of characters become the syntheses on the interpretation but in realities the students can expand the dimension of the synthesis into more than two dimensions. But this expansion is limited only as far as the objectives are concerned.

3. The principle of adjusted components. This principle shares the same principle as in the integration of different sounds with the synthesizer (the musical tool to imitate the natural sounds by synthesizing the basic sounds with different frequencies and volumes to create the wanted sound) or the mixing of different colors with different shades.

The synthesis-type of thinking to create new concepts can be accomplished in many steps as the followings.

Step 1: The identification of the objectives for the issues that require synthesis-type thinking. This step decides what data to seek, from what sources, and how to get it. And this step also identifies the data to be chosen and the proper methods in making logical linkages.

Step 2: The identification of the scopes for the relevant issues or the identification of the relevant issues to be used as the basic frame in the search for data sources. This step may start with opinion, knowledge, memory or previous experiences that the students have acquired on those issues. If the students start to synthesize what issues to be related, they should make it together.

Step 3: The identification of the characteristics and the scopes of the things or events to synthesize including the sources of reliable information in order to achieve the reliable data synthesis, the competent source, and the most up to date data sources. These activities build the accurate and insightful data.

Step 4: The selection of only the relevant concepts. This step selects certain issues to be put in the drafted concept or the data structure from the earlier plan, picks only the core concepts of the data that respond to the objective, and ignores the irrelevant accessory details. The issues to be taken must be pre-pondered carefully, i.e. what to use, how to use, where to use, when to use, and why use it. In order the check of the appropriateness of such issues then the synthesizers put them in the whole

structure or frame. The overall picture reveals the synthesis, the systematic draft structure, and the relevant data to the objectives.

Step 5: The arrangement according to the frame or the draft structure. To respond to the objective, this arrangement brings all the data together and categorizes them according to their category of important issues and less important issues (in order of priority). The data may have various characters with different details. There are some positive and negative features that already appear. If the data have so many interesting or useful issues, or may have contained unknown information, the students may pull those issues and adjust the concept draft frame or structure to create the core (or the new structure).

Step 6: The experimental step of new draft structure or frame after the synthesis of the draft project or structure with complete contents. The students try to synthesize the draft and test the structure in order to check its appropriateness. Using the critical and analytical thinking to test the draft of synthesized structure or frame in use for its propriety. The students revise anything that needs adjustment after this test.

Step 7: The application of the synthesized information into practical use. This is the last step of the synthesis-type thinking in order to create a new concept. After getting the complete synthesis, the students apply the results of synthesis-type thinking to use according to the objectives.

Similarly, Ministry of Education has composed the steps for the synthesis-type thinking, which are (1) the study on the component or analyze the data, the identification of the objectives of the new things for synthesis, (2) study the data that meet the objectives, (3) select the data and bring the data to arrange the framework to create new things, and (4) create the new things according to the objective or integrating the chosen data appropriately and apply them to use (Ministry of Education 2005: 61).

In studying the behaviors that reveal the capability in synthesis-type thinking, Ministry of Education (2005: 61) identifies the behavior that show the level of skills in synthesis thinking, which are (1) the analysis of the components or data, (2) the identification of the objectives of the new things to be created, (3) the selection the group of data that is appropriate to the objectives and arrange the data according to the

proper structure, (4) the synthesis of the framework according to the objectives, (5) the creation the new things according to the objectives, and (6) the application of the new things to use.

From the studies on the skills of synthesis-type thinking above, it shows that the synthesis-type thinking means the ability to show or express behavior of linking or connecting the things or concepts that have no immediate apparent relationship to one another to become a new thing or concept. After that, the students adjust the components to be various interesting parts that these parts can be used as required. The characteristics of the synthesis-type thinking can be classified into two, which are (1) the synthesis to create a new concept and or the work plan and (2) the synthesis of the relationship. In the process to train the students for synthesis thinking, this study concludes that the training is generally done in six main steps: (1) the identification of the topic or the title, (2) the identification of the objectives, (3) the study on relevant data, (4) the arrangement or organization of the selected data, (5) the crosscheck of the new concept, and (6) the application for practical use. In addition, these steps are important to implant into the students the ability of synthesis-type thinking, i.e. the ability of synthesis thinking, the analysis of the components or the data, the identification of objectives, the selection and arrangement of the data appropriate to the objectives, the synthesis of the framework according to the objectives, the creation of the new things, and the practical use. The teachers should train the learners to integrate the things that are not related with one another into a new thing by using the synthesis-type thinking skills. The components and the known principles can help the learners to adjust the components and apply the skills of synthesis thinking according to the objectives.

This research utilizes the known concepts to design the training activities for the synthesis thinking skills in the six steps which are 1) to identify the topics that may require synthesis, 2) to identify the objectives of the new things created from synthesis, 3) to study the data related to the objectives, 4) to arrange the data and select the data to arrange the framework concept to create new things, 5) to test the concepts or the new things and revise them when necessary, and 6) to bring the concept or the new thing to use according to the objectives.

1.3.3 Critical Thinking

Critical means the nature of wisdom or intellect that knows and offers correct reasons (Royal Institute Dictionary B.E 2525: 765); another meaning is thinking carefully according to the principles of evaluation. Other evidence refers to the contents with the possible conclusion including the consideration of all the relevant components and the use of the logical psychological process (Good, 1973: 680). The last argument is consistent with Hillgard (1962: 337) and Ennis (1985: 1-2) who state that the ability to judge statements or problems is reasonably and logically connected to one another. The reasonable reflective thinking is important in making decision to believe in something or to decide what should be done. Besides, the concept of Dewey (1933: 118) also supports that critical thinking is started from the complicated situation and ended with clarity. Those who use the carefully critical thinking for a long time use the knowledge as the base of their thoughts. The conclusions tend support the belief.

For the important component of the critical thinking, Dressel and Mayhew (1957 cited in Chalinee Aeimsri, 1993: 13-14) contribute that the persons with critical thinking will show abilities on five aspects as the followings.

1. The ability to define the problems, which is composed of the ability to be aware of the background of the problems and the ability the identify them.

2. The ability to select the relevant data to answer the problems.

3. The ability to define the basic agreement(Recognition ofAssumption).

4. The ability to identify and select assumptions.

5. Ability to make reasonable conclusions and make some sound judgments in reasoning, which is composed of the ability to make reasonable conclusion using the basic agreement, assumptions, and relevant data, and the ability to judge the data reasonably according the processes that lead to the conclusion. This ability to evaluate the conclusion is based on the application.

The concept of Dressel and Mayhew shows similarity to the concept of Ennis (1989: 14 cited in Lumyai Sananrum, 1999: 16-17) who notices that the critical thinking has two components: 1) the characteristics of the persons who have critical

thinking (Dispositions) and 2) the person's abilities (Abilities). The two components have the followings details.

The components of the characteristics of the persons with the critical thinking are making questions or searching for information from the previous issues, searching for the reasons, expressing opinion logically, making reliable references of the data sources, making understanding about the problematic situation, telling about the main or important contents, memorizing the basic knowledge or foundation of knowledge, creating alternatives/options, cultivating an open mind that readily accepts or considers opinions of others, having point of views, and showing ability to change points of view with enough evidence and supports. The further list of the characteristics of the persons with the critical thinking are their willingness to seek for more reasons for the correction, to arrange things systematically, to bring their abilities of critical thinking to use, to be perceptible to the feelings in gaining knowledge and in citing reasons of others.

The following abilities are the building blocks of a person's abilities on critical thinking: have clarity in the basics (Elementary Clarification), asking questions direct to the issues (Focusing on a Question), analyzing by using the reasons or logics (Analyzing Argument), asking and answering challenging questions clearly (Asking and Answering Question That Clarify and Challenge), having supporting data (Basic Support), considering the reliability of the data source (Judging the Credibility of a Source), having skills in observation (Making and Judging Observations), making summary (Inference), making deduction (Making and Judging Deduction), making induction (Making and Judging Induction), making the judgment on values (Making and Judging Value Judgment), having clarity (Advanced Clarification), identifying the problems and explaining the definition of the problems (Defining Terms and Judging Definition), using basic agreement (Identifying Assumption), having strategies and tactics (Strategies and Tactics), having capacity of decision-making when doing action (Deciding on An Actions) and building interaction with others (Interacting with others).

The processes of critical thinking, according to the concept of Robert Ennis (1985: 44-48), are built out of 12 steps as the followings.

1. The identification of issues or problems. The important problems should be identified clearly, as well as the criteria to judge possible answers.

2. The analytical thinking debate through the identified reasonable and reliable data. The thinkers identify and weed out the information and data that are unreliable. The thinkers identify the similarities and the differences of the opinions about the existing data and can make conclusions on their own.

3. The setting up of challenging questions and answers for them clearly. The samples for the questions used such as "why", "what's the important issues," "what's the definition of the identified statement," "what are the possible samples," "what is your opinion about this issue," "what's the differences," "what is the reasonable data," "what is unreliable data", or "do you have additional opinion".

4. The judgment for the reliability of the data sources by crosschecking the information from the trusted experts, the data with little debates, the exceptionally trusted data, and the reasonable data for logical reasons.

5. The observation and judgment for the soundness of the data used through the observation of the five senses of the thinkers (not just from the hearing of others) and the data received from the immediate note-taking after the observation by themselves (not notes from the memory only).

6. The use of the logic of deduction and the decision based on deduction, which enables the thinkers to highlight the general principles and apply them into specific cases in various conditions.

7. The use of inductive logic and the decision based on induction, which allows the thinkers to conclude the general principles applicable to the large population group from the correct data collection from the specific cases.

8. The judgment and the evaluation on the alternative options through sufficient basic information, which differentiates between negative and positive possibilities before the thinkers make decision.

9. The formation of the definition in words (e.g. the puns or similarities in rhymes), the decision-making, the identification of categories in groups, the operational definitions, and the preponderance of the right or wrong examples.

10. The identification of the workable assumptions.

11. The judgment to implement the identification of the problems, the selection of the criteria to judge the possibilities, the identification of various options, the identification of choices among the options to practice, and the review of the options with logics.

12. The interaction with the others. For the process of the critical thinking, the documents of Ministry of Education (2005: 72) identifies that the critical thinking process is composed of the following five steps.

1. Observation, which is the capability in data processing to sense the details. It can take forms in pictures, objects or events without added opinions.

2. Clarification for data or problems in terms of their levels of correlation to the causes of the problems and the relevant data.

3. Prediction of the possible answers, which is the evaluation on the data with good level of correctness, sufficiency, and reliability. The background concept for this prediction of possible answers (which are expected to take place) is the criteria to judge the likely answers out of the problems.

4. Arrangement of the data such as the classification of the facts and opinions, all of which are used for finding the relationship between the data and the group category by using the logical principle in judging data in order to get the reasonable options, alternatives or answers according to the existing data.

5. Conclusion out of the data by using the logic is the summarized proposition about the data by using the appropriate options or alternatives after the thinking (critical thinking on the negative or positive consequences),e.g. on good and bad consequences, short-term and long-term effects, and the values after the implementation.

The promotional campaign for the teaching of the critical thinking, Department of Curriculum and Instruction Development (1991, cited in Tisana Khammanee et al., 2001: 152-153), proposes the activities to train critical thinking as the followings.

1. Train the students to have observation skills by emphasizing on training on perception activities with multiple choices that the students have abilities to

conceptualize, to connect among things, and to assess the consistency or the relevance of the evidence and data to the conclusion.

2. Train the students to have the skills on explanation by asking them to answer the questions in which they have to show opinions (agreement or disagreement) emphasizing on the use of reasons, principles, roles or regulations, and evidence to support their opinions.

3. Train the learners to have the listening skills by listening to opinions of others and answering the questions to criticize the others' opinions emphasizing on the adjustment of their previous opinions based on reasons or information without reference to emotion or stubbornness about their own opinion.

4. Train the learners to have the skills on connecting the facts through arranged activities to compare the differences and similarities of things or facts. Then they categorize in groups of things with similar characters, and they make connections of events or situations with reasons. They must find the rules or criteria to connection facts or events in form of comparison.

5. Train the learners to build the critical skills by allowing them to analyze events or situations, statements, concepts or actions to find (within these subjects) the strong or weak points, positive or negative aspects, the importance or accessory parts by giving examples with principle-based explanations along with the critique.

6. Train the students to have the skills to summarize or conclude the activity arrangement such as judging the components of action or data that connect one part to another and concluding correctly according to the weight of evidence or data.

In one the studies on the behaviors correlated with the critical thinking, Ennis (1989, cited in Lumyai Sananrum, 1999: 16–17) states that the persons with critical thinking show 13 strains of characters, which are (1) setting up questions or searching for data in known stories, (2) searching for reasons, (3) expressing with reasonable clarity, (4) using reasonable data sources, (5) trying to unravel the problematic situations, (6) telling about the importance of the contents or whole stories, (7) memorizing the basic knowledge, (8) creating alternatives or options, (9) cultivating an open-minded, accepting others' opinions, using the logics to be the

starting point and accepting decisions based on solid data and sufficient reasons, (10) having point of views and changing flexibly the point of views with sufficient evidence and reasons, (11) looking for more reasons to verify the correctness of information, (12) arranging stories or issues systematically, and (13) acting sensitively to the level of knowledge involved and the quality of reference of others.

Upon the assessment of the definitions of Ennis, it immediately shows that they are consistent with Ministry of Education's identification of the persons with critical thinking as showing seven distinct characters; and this study builds the evaluation form for the marked behavior of critical thinking as the followings (Ministry of Education, 2005: 71).

1. Ability to identify targets of thinking correctly in the right way.

2. Ability to identify the important issues of thinking clearly.

3. Ability to process the data (both facts and opinions) related to the issues at hand, in considerable extent, using alternatives, and in long terms.

4. Ability to analyze and select the data the data to use for thinking.

5. Ability to evaluate the data.

6. Ability to use the principles of logics to judge the data and present the answers or reasonable alternatives.

7. Ability to choose the alternatives or to agree on the issues under discussion.

From the studies on the development of critical thinking skills, this study can conclude that the critical thinking means the reasonable and careful judgment through the use of the brain processes in proposing the judgment, good targets, reasons, and evidence on the conclusions relevant to the issues. Critical thinking starts from the complicated situation and ends with situation that has been critically thought with reasons to reveal the priority rank before producing decisions, beliefs and practices. For the concept on components on critical thinking this study can divide the important issues of the training process into five steps, which are (1) the training to give the definition of the problems, (2) selecting the relevant data in order to find the answers to the problems, (3) identifying the assumptions, (4) making consensus reasonably, and (5) the evaluation, making decision and putting them into

practice. In addition, this study presents the guidelines to promote the critical thinking, in which the teachers allow the students to study regularly using the observation skills, explanation skills, skills on connecting facts and relationships, skills in balanced criticizing over others' opinions, and the skills on summarizing the findings or conclusion-making. The interesting activities are arranged according to the ages and differences of the students in the attempts to implant the behaviors that indicate critical thinking.

1.3.4 Creative Thinking

Creative thinking is about Fluency, Flexibility, and Originality (Guilford, 1959), which are rather similar to the argument of Somsak Phuvipadawat (2001 : 2) who concludes that creative thinking is a complicated and difficult set of traits to define. Although certain limited definition can be offered but generally the creative thinking is considered as related to the tasks (products), which are original, valuable and acceptable. If considered in terms of the process, the creative thinking process is involved in inventing the connections or relationships among things, concepts, or opinions, which are similar to one another. Considered in terms of person, those creative persons must be unique (Originality) in themselves, fluent (fluency) in their thoughts, flexible in their thinking (Flexibility), and detail-oriented in their thinking.

The Structure of Intellectual Theory of Guilford explains that creative thinking is the capability of the brain to think in all directions or divergent thinking. There are four components in the creative thinking (Aree Rungsinan, 1985: 29-30) which are the followings.

1. Creative thinking means the original opinions or characters. The characteristics of the original opinions are different from the normal and simple opinion. The originality of the opinions brings usefulness for others.

2. Fluency (Fluency) means the amount of thoughts that are not reproduced in the same issues, and fluency can be classified into the fluent thoughts in words, fluent thoughts in making connections, fluent thoughts in expressions, and fluency in thought itself.

3. Flexibility(Flexibility) means the type of thoughts that can be classified into two: immediate flexible thoughts, and adapted flexible thoughts.

4. Elaborated thought (Elaboration) means the abilities to see details which others can not see, including seeing the meaningful connections of things (Office of National Education Commission, 2001: 30–31).

Some of the studies about the process of creative thinking, including the interesting study by Paul Torrance (1971: 35-41), proposed the elaboration of creative thinking into five steps, which are 1) searching for the facts starting from the feeling of complicated confusion without a known cause, or trying to think what are the causes of the confusion, 2) searching for problems, or considering consciously to understand the anxiety, confusion, complication and recognition a problem exists, 3) searching for the concepts to set up assumptions and gathering the data in order to test the assumptions, 4) searching for the answers for the test of assumptions until one gets the answers, and 5) accepting the outcomes of the findings, formulating the answers, publishing them, and thinking further for what these findings may lead to (new concepts or new things). Wallach (1926 cited in Somsak Phuvipadawat, 2001: 17-18) proposed that there are **four steps** in creative thinking process, which are the preparation, the incubation, and checking. In addition, Osborn (1957, cited in Aree Punmanee, 2002: 9) stated that the creative thinking process has seven thinking processes, which are the identification of problems, the preparation and collection of data, the analysis, the thoughts, the further thinking and clarification, the resulting synthesis, and the evaluation.

For the building of the methods to train creative thinking skills, Ministry of Education (2005: 77) identified four steps as the followings.

Step 1: identify the problems in thinking, creative thinking is the thinking with targets and purposes. It must start with the identification of the objectives (solutions for problems). It may use certain techniques to set up questions to lead to the right answers.

Step 2: seek for new concepts, or trial to find the guidelines to solve the problems which are taking the forms in original concepts out of the known frame. This step is very important in the creative thinking process.

Step 3: evaluate and select the concepts, or to use logic in considering if certain concepts can be used to respond to the set objectives or not, before making decision to choose the most appropriate concept. This step requires the use of the thinking from the other dimensions such as the analytical thinking, or synthesis-type thinking.

Step 4: creating the new products following the chosen concepts.

In the activities arranged to develop creative thinking, Davis (1991: 236–244) has stated about enhancing creative thinking through several techniques which can be summarized as the followings.

Brainstorming, which is the technique to enhance the climate of freely expressing ideas or concepts, can stimulate the imagination and positive attitudes towards creativity. Accepting a strange idea, which the teachers and the students have been considered only lightly, can happen through the brainstorming before the identification of the problem solution takes place. The analyses on the brainstorming techniques had been done by many interested scholars. The interesting concepts or opinions are presented as the followings.

Osborn (1957 cited in Ministry of Education, 1999: 120) proposed the activities that use the brainstorming techniques to develop creative thinking in formal group activities with the objective to enhance the divergent thinking among the participants and to think a lot in limited time. Everyone in the group can express freely one's opinions. This brainstorming technique has several steps as the followings.

Step 1: The activity group is made of 10 to 15 persons sitting in a circle.

Step 2: The head of the group presents the problems or the issues to which the participants must find answers or show opinions from all possible angles.

Step 3: The participants are urged to think of as many as possible answers without judging the others' opinions as right or wrong or good or bad. No criticism toward others' opinion is allowed. Everyone must openly accept the opinions of the group members.

Step 4: The answers are recorded to be used as the guidelines for thinking in other larger aspects.

Step 5: When the time is up (after 15–20 minutes) the participants categorize their own ranges of opinions into groups.

Step 6: The group members identify the evaluation criteria then begin to evaluate all of the thoughts. If the group members accepted that they have found the valuable and creative methods to solve the problems, then the issue was settled. More problems can be brought for further brainstorming sessions.

Rothwell and Kazanas (1989 cited in Chit Nuankeal, 2000: 48-50) also present several of the brainstorm techniques as the followings.

1. Brain Writing Technique, which is very similar to brainstorming methods, emphasizes that the ideas are put in the written forms; and this method can be divided into two sub-methods.

1.1 Brain Writing Pool is the method starting with the announcement of the problems to the group members. Afterward each of the members jots down the possible methods to solve the stated problems in a piece paper and then each member places the paper in the center of the group in an appointed time. After that each person picks one of the papers of the other members to record the methods, which are likely different from the picker's own methods. Then they finish the recording. Then the group members start the discussion to find conclusions.

1.2 Battle Build Mapped Brainwriting is the method that starts with reading out loud the problems to all of the members. After that all members propose verbally the methods to solve the stated problems in appointed time. Then the brainstorming facilitator shows many pictures that are not immediately relevant to the problems at hand. After that, everyone takes note the guideline to solve the problems that they can think after seeing the pictures. Then everyone takes turn to read one's solutions to the other members that the new original opinions can come up to be discussed further.

1.3 Crawford Slip Writing Technique is composed of some sub-steps starting from giving out 25 pieces of paper with the size of 5 times 3 inches to each participant and reading the problems to them. Afterwards, everyone writes the solutions to the stated problems in the piece of paper in appointed time. After everyone

finishes with writing, then the facilitator gathers the papers from all members and asks everyone to evaluate, categorize and discuss the problems together to find conclusions.

        1.4. Phillips 66 Technique is composed of some sub-steps and started with the division of the members into sub-groups (6 members each); and the members are urged to create familiarity among the members of each group. Then they choose their group's chairperson and secretary, who read the problems to the group members. They help one another to propose the solutions within 5 to 15 minutes. Finally the representative of the groups reports the outcomes in 6 minutes.

        2. Identified Important Attributes (Attribute Listing) is composed of two sub-techniques which are the following.

        2.1 Attribute Transferring is transferring of attributes of one thing to be compared with other things.

        2.2 Attribute Modifying is improving the characters/attributes which are listed by the members to get desired attributes.

        3. Synthesizing attributes(Morphological Synthesis or checkerboarding) which are identified attributes of thing using the Matrix table system as a guideline in identifying the main attributes along vertical line and identifying other attributes along the horizontal line in order to get attributes of the things that one wants to study in new ways.

        4. Checklist is arranging the list of possible thoughts on one thing then adjusting, adding, cutting, summarizing, expanding those thought in order to arrive at opinions according to the list.

        5. Synectic Analogy is done in three models as the followings.

        5.1 Direct Analogy is making comparison of the apparently similar characters. This principle was invented by Gordon (cited in Joyce and Weil, 1986; cited in Chit Nuankeal, 2000: 50). The example for this kind of creative thinking is coming from the direct comparison undertaken by Sir March Isumbard Brunels (an engineer) who observed the grub that made holes on the wood and suddenly got a creative idea of making the under-water tunnel.

        5.2 Personal Analogy is bringing the student's self to be compared with the problems or things under study. Gordon stated that this method helped the

students to understand better the thing they study. For example, the teachers may ask the students to compare themselves to a car, which should be warmed up in the morning, or recharged when its batteries are exhausted, or when the car reaches the traffic lights. The comparison of student's self with the other things can be divided into three models.

5.2.1 The facts. For example, about the car care the student will naturally know that "the engine will be hot" when the engine is started to warm up.

5.2.2 Emotion, which takes place when the students feel emotionally powerful when they compare themselves to the cars with engine already starting.

5.2.3 Empathetic Identification with a Living Thing is taking place when the students try to understand the living entities by comparing themselves to these entities. The students try to understand the non-living things such as students feel they are overused by the owners of things or a car (can not stop running by itself but must be driven) when the students compare themselves with a car.

5.3 Fantasy Analogy is allowing the students to imagine to the methods that they want to use for solving problems or performing the tasks. In comparing this principle with a rather similar principle, Gordon presents the Compressed Conflict in which the players compare two words that contrast each other and juxtapose them in order to create a new thought or concept such as the word "Enemy who is Friendly", or "Criminal who Saves Lives." This kind of comparison provokes students' flexibilities and frees them from the strict adherence to the rules and regulations; they may create new inventive concepts.

For the study on the behavior which indicate the ability of creative thinking, Aree Punmanee (2002: 75-76) stated that the characters of the children with creative thinking would differ from the average children in the following manners. First, the creative children show a distinctive level of curiosity and love to learn most of the time. Second, they like to seek for knowledge, study and launch experiments. Third, they like to ask questions or making inquiries with unexpected questions. Fourth, they are curious and tend to be astonished by things they see. Fifth, they like to observe or to see the small unusual things (something strange), which they can

notice quickly and easily. Sixth, they like to reveal more than to keep the outbursts of emotional reaction inside their minds. If they become curious on something, they will ask or seek for answer for the curiosity. Seventh, they have good sense of humor and see things in surprising angles; they tend to show their sense of humor. Eighth, they tend to have good concentration on the things of interests. Nine, they enjoy playing at the thought. Tenth, they are interested in unusually so many things. And eleventh, they prefer to be their natural selves.

Ministry of Education (2005: 76) identifies the characters indicating the person's distinct capability in creative thinking as the followings.

1. They are able to identify the scope of problems clearly and the appropriate problem solving. After they set a certain set of targets, their objectives are to find a better, more creative problem-solving method.

2. They use imagination to judge the problems to creatively solve them.

3. They select the guidelines or methods to solve the problem strategically such as to think about the problem on their own and to discard irrelevant facts or alternatives.

4. They evaluate the alternatives efficiently, classify them, and select the good and appropriate thoughts.

From the study on the known concepts of creative thinking above, this study concludes that the creative thinking is a complicated brain process that leads to the discovery of new concept or thing. This discovery requires the components which are fluency, flexibility and elaboration in the thought. The characteristics of the persons with creative thinking can be divided into two types: the processing creative thinking and the product creative thinking. In the training process to enhance the creative thinking, many scholars offer various concepts. When these offers are compared, they are consistently sharing the basic concept of Torrance who divides creative thinking into five steps: search for facts, search for problems, search for explanatory concepts, search for answers and acceptance of the discovery. In building the learners' creative thinking, there are many teaching techniques such as the brainstorming with has more sub-techniques (Brain Writing, Attribute Listing, Morphological Synthesis and Checklist). Beside the Synectic Analogy there is also a

suggestion for the teaching method to enhance the creative thinking called "Williams Cube CAI Model" from Williams who arranges the learning to enhance the creative thinking skill for learners. The concepts or theories for these presented studied are set to be the guidelines for appropriate application in this present study. In this study, the above concepts are used to design the training for enhancement of the creative thinking skills. This study identifies the training process for creative thinking skill as divided into four steps as the followings.

    1. The identification of the problems in thinking.

    This study sets to train the students to have chance to thinking purposively and clearly with certain objectives beginning from the identification of the objectives (of solving the problem). The teacher may use the technique of setting up questions or to urge the students to be able to identify the thinking problems.

    2. Seeking out for new concepts.

    This study attempts to train the students to think to find a guideline to solve the problem by using the original concepts out of the known frame. The thinkers must prepare and study the basic data, which are the facts necessary to solve the problems, and present the concepts and solve the problems as hard as possible. Then they bring those concepts to create categories by using the set criteria and add the original concept to get the new, original and valuable guideline for problem-solving.

    3. Evaluation and selection of the concepts.

    This study tries to train the students to use logic and to judge the fact with the useful concepts. The questions posed are "are the solutions reasonable?" "How much can the concepts respond to the objectives before the students consider taking the most appropriate one? This step requires the thinking from the other dimensions such as the analytical thinking, the synthesis- type thinking and the critical thinking.

    4. Creation of a new product according to the chosen concepts.

    This study strives to train the students to see the main details and small details about the things or issues under consideration. Then the students practice to create a new product after making decision based on the choice over certain concepts.

1.3.5 Metacognitive Thinking

Metacognitive thinking is a structure of a thinking process within the learner's mind. If the learners are capable of critical thinking, creative thinking and critical thinking, these modes of thinking ease the learners to build a strategy of thinking on their own. These learners can also supervise and control their own thinking processes (Somsak Sinthuravech, 2000: 5). This observation is consistent with that of Bake and Brown (1984, cited in Tisana Khammanee, 2001: 156), which notices that these able learners can control and self-evaluate their own thoughts, capable to control the intellectual or thinking processes, stay aware on the tasks, and can use efficient strategies to complete the tasks. The findings of some known research show that the learners with high study achievement belong to the group of people who have passed the metacognition development and thus can control and supervise themselves to be able to think properly. In addition, Wenden (1985: 4-13) states that metacognition is a method that the learners can use to control and oversee their own learning on many aspects as the followings.

1. Making the learning plan (Planning) is the setting of the learning steps in order to decide the subjects the learners want to learn and the methods the learners want to use for efficient learning. Besides, the learners must set the objectives and standards through which they can measure their own learning achievements.

2. Controlling and supervising the language use (Monitoring) is the aspect in which the learners realize their own mistakes on the language use and learn to fix those mistakes. This aspect shows that the learners are responsible to learn and lead to the success in learning languages.

3. The evaluation of the learning (Checking Outcomes) is the aspect in which the learners are interested with the results of their attempts in learning or using the second language. The true objective evaluation must be the objective of the learners in considering the benefits and making decision to use certain methods to learn language.

O'Malley (1983 cited in Jinda Koochareon, 2001: 12) stated that metacognition means the knowledge about processes that can bring knowledge, understanding, knowledge-based control or self-arrangement through use of the

planning process, checking and evaluation. In addition, Babbs and Moe (1983: 77) confirm the opinion that metacognition is the ability to check the knowledge in term of cognitive domain or the thinking process that controls what we are thinking while we learn. Similarly the Office of National Education Commission (2001: 37) identifies that metacognition is the knowledge about the tendency of oneself and the knowledge about internal processes and conditions. This knowledge includes the control which relates to the process and cognitive domain activity. This is the learning to which the learners are conscious and thus have knowledge about the learning process within themselves. They also have capability and tendency to control such process while they learn.

For the components of metacognitive thinking, Baker and Brown (1984 cited in Tisana Khammanee, 2001: 157) divided it into two components which are the awareness of strategic skills as well as the sources of data that require efficient working and the knowledge of What to do with their own capability in self-regulation to work as well as knowledge of how and when to work on it.

Flavell (1985: 66) claims that metacognition has two components which are the Metacognitive Knowledge and the Metacognitive Experience. The details for these two components are given as the followings:

1. The Metacognitive Knowledge is a part of all knowledge that persons have accumulated in their long-term memory. Flavell divides the knowledge in metacognition into three further variables which are the personal variable, the task/product variable and the strategic variable and he explains about these variables as follows.

1.1 The personal variable means the person who has the knowledge about the characteristics that the ordinary people have in term of intelligence, in learning or in working.

1.2 The task variable means the awareness of the characteristics of accomplishing the work, which affect the work performance of the person. This variable is related to knowledge about the factors that harden or ease their tasks, including problem and obstacles of the tasks which might occur to the persons.

1.3 The strategic variable means the knowledge of a person on the appropriate strategy to use in order to achieve the targets of work efficiently.

2. The Metacognitive Experience is the thinking experience that a person can control and is important for the person's Self-Regulation in doing thinking activity.

In using the metacognitive experience, the persons control and self-regulate themselves, e.g. observing themselves, judging the process and the self-reaction processes with the objective to change their behavior into the desired targets. This metacognitive experience has further three sub-components, all of which are thinking activities as the followings (Brown, Bransford, Ferrare and Campion, 1983 cited in Office of National Education Commission, 2001: 38).

2.1 Planning is to know by self how to do the tasks, starting from identifying the objectives to performing the tasks until the measurement of the achievement.

2.2 Monitoring is the revision of thought about the plan. If it's possible, the appropriateness of the step orders and methods is chosen for Self-Monitoring or checking.

2.3 Evaluation is the thought about evaluation of the plan and the method to check and evaluate the achievement.

In the process to enhance the metacognitive thinking, Derry and Murphy (1986: 1-39) stated that the learners should be aware of what they must learn, what their purposes and should know the benefits of certain strategy and knowledge about the chances and method to use such strategy.

Osman and Hannafin (1992, cited in Office of National Education Commission, 2001: 39) propose a guideline to develop metacognition that it depends on two variables which are the methods to train and roles of the lesson content for the training.

Osman and Hannafin divide the training method into two types which are the integrated and the unattached. The development of the metacognition by using the training method called the integrated is a method that includes strategies. The method's importance and the scope bring the strategy to be used in the lesson. This

method shows that certain strategies can facilitate the learning in real situation and they incite the learners' interests and their good interaction with the learning contents (mixed contents). The unattached method involves the more international strategy. This strategy is taught freely from the criteria-based lessons with the aims of developing the students' capability to choose their own strategies. This method can create the skills that can be applied into many subjects.

The role of the learning contents during the training can be classified in types such as the strategy based on the contents and the strategy free from the contents. This study applies the strategy free from the contents because this strategy is largely accepted and can be applied to all types of lesson as well as all kinds of work in all skills. The "unattached" training method, or free from the contents, is the strategy that is generally taught freely in terms of time and content, thus making it various on contexts and contents. This kind of training aims to have high level of transferring. This method is composed of the basic strategy and other supportive strategy which help the learners to manage their lessons. This set of strategy covers the interpretation, the imagination, the creation of knowledge network, the analysis of important issues, the concluding and arrangement of a new structure. Integration is a part of the supportive strategy designed to develop and maintain the appropriate learning climate, both in cognitive and affective domains. Feeling is a strategy that helps preparation of the emotions, arranges the intentions, diagnoses the needs to learning, and helps the regulation of the system called dynamic learning.

In developing the metacognitive thinking skill, Pimpan Dachakupt (Ministry of Education, 1997: 160-167) proposes a strategy to develop it as the followings.

1. To identify what the learners know and what they do not know by writing clearly the respective parts. After the learners know the poorly understood topics, the learners try to understand or expand it with correct data.

2. To make conversation or discussion about the thinking methods, which are very important in the teaching and learning. The teachers explain about the thinking process in the planning session to solve the problems. It is the demonstration of thinking process so that the learners already understand. After this session is

accomplished, the teachers train the learners to think. They discuss about the thinking method of each individual and explain about the thinking process that it can be used throughout many learning techniques of cooperative learning (Co-op Co-op), speaking in pair (rally robin), and speaking around the circle (round robin). Speaking in pair (rally robin) takes place when a person exposes a thinking method to the other person. After that the listener takes the turn to express opinions on the same topic and the first speaker person becomes the listener. Then both sides take turn to talk and listen.

3.To create a journal to write about opinions or thinking processes. Writing journal or taking notes during learning will be done by the author or writer who records the thinking method, the precautionary moves, and the difficulties that reflect their own opinions.

4. To prepare planning and self-regulation. The learners must develop responsibility in planning and learn by themselves. If other person makes plan for the learners, the latter will not develop the learning development on their own.

5. To conclude about the thinking process to use while accomplishing the activities. The learners should discuss about the thinking process that it becomes the part of conscious development in controlling the thoughts and can apply them to use in other situations. This can be done in the following steps, which are 1) the teachers advise the learners to review activity, to collect data about the thinking process used and the feeling that occurs, 2) the teachers ask the learners to classify the thinking skills used, including the thinking strategy used, 3) the teachers ask the learners to evaluate the success, dismiss the inappropriate strategy away, and conclude the useful strategy in the future.

6. To self-evaluate is the evaluation of the students' own thoughts. This evaluation method can be trained incrementally and progressively. The trained students will eventually make the training as their second nature to be undertaken freely. After that the learners can begin to connect the experience from the learning and its use in any situations.

In conclusion, metacognitive is the knowledge and experience that control the activity about the knowledge and understanding about the thinking of a person. It covers the abilities to express or to behave with the components such as the

planning to identify working targets, the selection of the implementation methods, the arrangement of the order of practice, the categorization of the occurring problems and their solutions, the crosschecking of the planning, the self-regulation in order to follow the step of the implementation, the evaluate of the planning, and the performance until the end and the usage of the evaluation to improve the development. The training process of metacognitive thinking should allow the learners to learn the learning process arranged on their own that they can notice the influencing factors for their own study on cognitive domain. The training methods, the contents of training, the psychology of learning, the training on discussion together following after the training processes will produce the training achievement.

From the studies on the concept on the training process of metacognitive thinking this study can apply the design of the thinking training exercise on metacognitive thinking. By identifying the training steps in certain order, which are the planning to train the students to be aware of themselves on the methods to finish the tasks from the identification of the targets to the implementation until achievement, this study checks the order to review the possibility of the plan. This study also checks the appropriateness of the order of the priorities and the methods to choose the self-regulation or the self-check as well as trains the students to think about the evaluation of the plan and methods to check and evaluate the students' achievement.

1.4 Learning Theory and Theory of Intellectual Development (Tisana Khammanee et. al., 2001: 13 - 22)**.**

In the discussion on the concepts of relevant theory on the thinking skills, some thinkers show their different findings on the thinking concepts, which can be categorized into four main groups. The first group—Piaget's and Bruner's Theories of Intellectual Development—emphasizes the relationship between the intellectual process and the thinking process. The second group (the Conditions of Learning from Gagne) emphasizes more on the learning process. The third group (Guilford's Structure of Intellectual Theory) insists on the capabilities of the brain and believes that the capability of the brain grows from the practices according to the identified conditions in terms of characteristics on content dimension, performance dimension, and product dimension. The fourth group follows the theory of Guilford that analyzes

the concept of the foundation/basic concept for thinking skill development. These relevant concepts will be presented as the followings.

1.4.1 Theory of Cognitive Development of Piaget

Theory of theory of cognitive development of Piaget explains that the development of human intellect are the same at the same age and different in different age. The development of intellect is the result of interaction between a person and environment to which a person adapts to create an Equilibrium by using the Assimilation process and the Accommodation process until the person learns beginning from the Sensory-Motor Stage. Afterwards, the persons start to understand the abstract thinking and develop their mind to grasp concrete thinking. It is continuous development taking place in four steps which are the followings (Piaget, 1964, cited in David, 1985: 64-65). Step 1 or the Pre-Operational Stage takes place during the developmental period of children at birth until the age of 2. The children at this age begin to develop their second sensory-motor to control body functions starting from the age of 2 to 7. The children at this age will experience the development of their brain which will be used to control the development of habit characteristics and the functioning of all body organs. Step 3 or the Concrete-Operational Stage starts at the age of 7 to 11. The children at this age will have further brain development and learn to distinguish the abstract thinking although they still cannot imagine the abstract story. Step 4 or the Formal-Operational Stage is the last developmental stage of the children at the age of 12 to 15 when the children at this age can think logically and think about complicated abstract things or concepts.

1.4.2 Bruner's Theory of Discovery Learning (1956)

Bruner believes that all children in development stage can learn any learning content if the learning is arranged appropriately to their capability. Bruner classifies the intellectual development into three stages as the followings.

1.Learning from action (or Enactive Representation) is the learning stage which is related to the motoric-sensory, e.g. seeing example and following. This stage happens from the birth until the age of 2.

2. Learning from imagination (or Iconic Representation).   When the children get older about 2 to 3 months old, they would usually drop toys near the

cradle. If an adult takes the toys away, the children will be distressed and cry when fail to see the toys. Bruner interprets this phenomenon that the children can not see their toys and start to cry or get annoyed, or it shows that the children at this age already have pictures in mind (Iconic Representation). The children, for example, may think that shaking their hands and shaking the bell in their hands are the same things; when the bell disappears, however, the children pay no attention to that fact and they continue moving their hands.

3.Learning from symbols (or Symbolic Representation) is the step in which the children can understand the learning about abstract concepts. This is the highest stage development on knowledge and understanding because the children can think logically and understand the abstract concepts.

From the stages explained above, Bruner proposes a teaching method to allow the learners to discover (Discovery Learning) through the creation of the inner motivation (Self-Motivation) within the learners. They may become curious and want to discover the things around them. The learning structure should be arranged to fit the ages of the learners. The teachers arrange the sequence of difficulty according to the intellectual development of the learners. The reflection should be given to the learners to show whether they perform correctly or mistakenly (Self-Reinforcement).

1.4.3 Conditions of Learning Theory of Gagne

Gagne's theory has two important parts, which are the Learning Theory (internal conditions) explaining about the creation of learning and the Theory for Learning Arrangement (external conditions) explaining about the application of learning knowledge to be used effectively to enchance the learning (Gagne, 1985). He explains about the learning that there are three components, which are (1) learning outcomes or the human capability, (2) the learning process and memory (or the result of data processes in the brain), and (3) the results of the outside events that affect the learning process within human body. The details are as the followings.

1. The result of learning or the human capability of many aspects is the behavior representing the capability or qualities that have been developed from the learning of the learners. There are five types of them which are:

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       1.1 The Intellectual Skills means the capability of the learners in using the symbol for interpretation and usage. The Intellectual Skill covers the knowledge and understanding of the other sub-skills in four levels. Each level is the base of another in certain order. These are the Forms of Basic Learning, or making connection between the stimuli and the responses and the continuous learning in chain Association and Chaining. The sub-skills of each level are (1) the ability to discriminate (Discrimination) the physical characteristics of an object, (2) the abilities to categorize the objects or things (Concepts) by identifying their shared characteristics, (3) the ability to gather the conceptualization to form in group and set orders (Rules) to conclude the references and response to the stimuli correctly, (4) the ability to relate many rules together, which leads to complicated knowledge and understanding.

       1.2 Procedures of Higher-Order Rules Cognitive Strategies mean the processes in which human beings can help themselves to get data and arrange them to create learning as they perceive it. This process involves the stategy to attend (Attending), which is about the building of understanding about the conceptualization (Encoding). The strategy is about thinking of something in the memory (Retrieval). They are the parts of the strategy for problem solving and the strategy of thinking.

       1.3 Verbal Information includes data such as the statements, sayings, names or labels. The sayings can take forms in the statements, facts and meaningfully-organized verbal knowledge.

       1.4 Movement skills (Motor Skills)

       1.5 Attitudes

       2. The learning process and human memory. In explaining about the learning process and human memory, Gagne relies on the data processing from the brain as the base. Then Gagne explains this process by making relationship with the structure in each part in the following patterns.

       2.1 Data processing inside the brain The data processing in the brain occurs when the stimuli stimulate the nerve cells which are responsible to accept information and create electronic signal in the nerve in unique patterns according to the nerve cell system. The electronic signals remain in the data-recording unit of the

nerve cell in short period of time (about some hundred seconds). After that there is a
perception unit that filters the unwanted stimuli and sends the chosen signal
(containing data) to record and keep in the short-term memory unit that the data can be
retrieved for use later. After this process, the system turns the data interpreted as
"meaningful" into the long-term data and keeps it in the long-term memory.
Afterwards there might be some retrieving processes in the memory. In this stage, the
data will be processed in the short-term memory unit called the Working or Conscious
Memory. After that the control part will appropriately respond by sending the
feedback information or data. The observation of the result of one's action and the
follow-up reinforcement help human beings to learn certain remembered issues. In the
future whenever necessary event or stimulis appears, the memory system repeats the
mechanisms to remember the training for the learners' advantages.

      2.2 The process to control the implementation and expectation of
data processing inside the brain. These processes take place inside the human's body
and they are called the Executive Control Process and the Expectancies. Human
develop the capabilities in two ways since the learning in the past. Human beings have
a long-term memory mechanism in which the long-term information are separatedly
kept. Whenever an event or stimulus appears to affect the motoric sensory, the human
mind relies on the collected data that are kept in the long-term memory unit to consider
or choose achieve the required learning (in steps or recorded and collected data in the
memory).

      2.3 The results of the outside event that affects the learning process
of human. Gagne explains that while the process of the data arrangement inside the
human brain takes place, the events outside the human beings also take place at same
time either to promoting or constraining the learning process. The interaction between
the learning process inside the human brain and the positive influence may also come
from the outside events.

1.4.4 Guilford's Theory of Structure of Intellect Model

      Guilford (1967) believes that the capability of brain will appear in terms
of capabilities in many ways or components. The capability can be checked by using
the standard test of Guilford that proposes that the structure of intellect can be

explained (through the human brain's capability) using the Three Dimensional Model's methods such as Contents dimension, Operations dimension and Products dimension. The details are as following.

The first fimension on Contents asserts that the the objects or data, which are perceived and used as media to create thinking, can be classified into five types: Figural contents, Auditory contents, Symbolic contents, Semantic contents and Behavioral contents.

Second dimension on Operations means that the created thinking process is composed of five abilities which are the Cognitive, Memory, Divergent Thinking, Convergent Thinking, and the Evaluation abilities.

Third Dimension on the Products means that the capabilities are the integration of the contents and operations together that becomes the products. When human brain perceives the objects or data, the six kinds of thinking process occur in a series of Units, Classes, Relations, System, Transformation and Implication.

The Structure of Intellectual in Guilford's theory is composed of small (micro) units from three dimensional forms equal to $5 \times 5 \times 6 = 150$ units. Each unit is composed of content (5) - operations (5) – products (6). In the structure of intellectual theory of Guilong, he argues about Creative Thinking, Reasoning and Problem Solving by analyzing the components. Guilford found that creative thinking is thinking in many ways that can solve problems and lead to a new creation (Guilford, 1959). Therefore he explains the creative thinking by comparing it to the structure of intellect especially on the thinking processes Operations and the divergent thinking by using the dimension of contents and products according to the old structure. Therefore the micro unit, which represents the the capability of creative thinking, is standing at $1 \times 5 \times 6$. In addition, Guilford (1967) explains about the thinking pattern to solve problems in general that the process of the brain on Memory, Cognition, Divergent thinking, Convergent Thinking and Evaluation. These five aspects are integrated together when a person experiences the environmental problems. Someone will learn about the relevant structure of the problems and adapt it to one's knowledge kept in the memory. Sometimes the data are adjusted before the synthesis and categorized whether they are relevant or irrelevant. Then one would try to solve the problems in different ways. The

problem-solving process can take place through the use the divergent thinking or convergent thinking back and forth depending on the nature of the problems or the acceptable nature of their solutions.

From the observation above, this study can use the method of selecting the sample group which is appropriate to try the training activities on thinking skills. The children at the age of 12 to 14 are the subjects of Piaget's study and the findings reveal that these children can think logically on complicated or abstract things or concepts. Piaget's observation confirms the proposition of Bruner who thinks that the children at this age range can learn from symbols or the abstract concepts. In addition, the design of the training activity for thinking skills will be based on the teaching principles offered by Bruner. This present study would create the inner reinforcement by using the challenging activities that would stimulate the curiosity of the children, the arrangement of activities from the easy to the difficult ones, the reflection to the learners that they realize if they perform correctly or mistakenly, and the self-learning design to most of the training activities to create a child-centered learning method.

1. 5 Measurement and evaluation of the ability to think

Tisana Khammanee et. al., 2001: 169-175) stated that the guideline to Measurement of capability in thinking can be divided into two sources as the followings.

1. The guideline from the "psychometrics group"

This guideline of psychometrics is the group of scholars who measure the education achievements and psychologists who try to study and measure the inner characteristic of human for over a century. This group started from the study and measurement of intelligence level. This kind of scholars studies the structure of human brain with the belief that each individual has unique characteristics and capability levels. These differences can be measured by using the standardized tests. Later this idea expands from simply measuring the brain capacity to the measurement of achievements, personality, Thinking Abilities Test (Aptitude Tests) and others, including the thinking abilities.

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2. Guideline from the "Authentic Performance Measurement group"

This guideline of measurement is an alternative for the evaluators on the learning measurement in the natural context by emphasizing the measurement of the authentic performance in real life or similar to the real life and worthwhile to its performers. The dimensions of measuring the complicated thinking skills include the performance of the task, the cooperation in solving problems and the self-evaluation. The techniques used for the measurement range from the observation of the task-performing, the essay writing, the problem-solving capacity in the real world situation, to the collected works in the Portfolios.

The measurement of thinking capability according to the Psychometrics group are mostly undertaken to measure the capability on the Critical Thinking. Although there are so many tests developed, this study discusses only two broadly defined types of measurement tests on thinking: the known Standard Tests for measuring thinking abilities and the tests for thinking abilities which were created for personal use (Tisana Khammanee et al, 2001: 169-175).

1. The known standard tests for measuring the thinking capability

These standard tests were created and used to measure the tested subjects' thinking abilities. The standard tests can be classified into two types, which are the General Thinking Tests and Specific Thinking Tests (Ennis, 1985, Norris and Ennis, 1990). The details are given as the followings.

1.1 The General Thinking Test aims to cover the thinking capability with the base of general knowledge. Most of them are administered to the tested subjects in multiple choices.

1.2 The Specific Thinking Capability Test aims to measure the thinking capability especially on certain skills such as the deductive thinking and the capability to evaluate the data through observation.

2. The created measurement test for personal use

If the standard tests fail to meet the measurement target such as the focus of the measurement, the focused scope of the thinking abilities,or other targets, the evaluators usually need to create the measurement tests which meet their personal purposes.

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There are principles to create the tests to measure the levels of human thinking abilities. The creator of the tests must obviously understand the theories of thinking processes in order to use it as frame or general structure. After identifying the operational definitions of the structure or the thinking components and processes, the test creators select some indicators or the behavioral characters (especially the abstract behaviors) to use. These indicators can identify to the structures or the thinking components. Afterward the test creators write the statements according to the indicators or behavioral characters, especially for each thinking component as the following diagram.

Things to measure
(Abstract)

Abstract
(indicators)

Tools used for

Measurement

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┌─────────────────────────────────────────┐
│           Thinking Capability            │◄┄┄┐
└─────────────────────────────────────────┘   ┊
                    │ ┄┄┄ Related theories    ┊
                    ▼                          ┊
┌─────────────────────────────────────────┐   ┊
│           Structure or component         │   ┊
│           Of thinking capability         │   ┊
└─────────────────────────────────────────┘   ┊
                    │                          ┊
                    ▼                          ┊
┌─────────────────────────────────────────┐   ┊
│   Operational definition of each component│   ┊
└─────────────────────────────────────────┘   ┊
                    │                          ┊
                    ▼                          ┊
┌─────────────────────────────────────────┐   ┊
│   Write behavioral-based questions that  │   ┊
│   represent and cover each component     │┄┄┄┘
└─────────────────────────────────────────┘
```
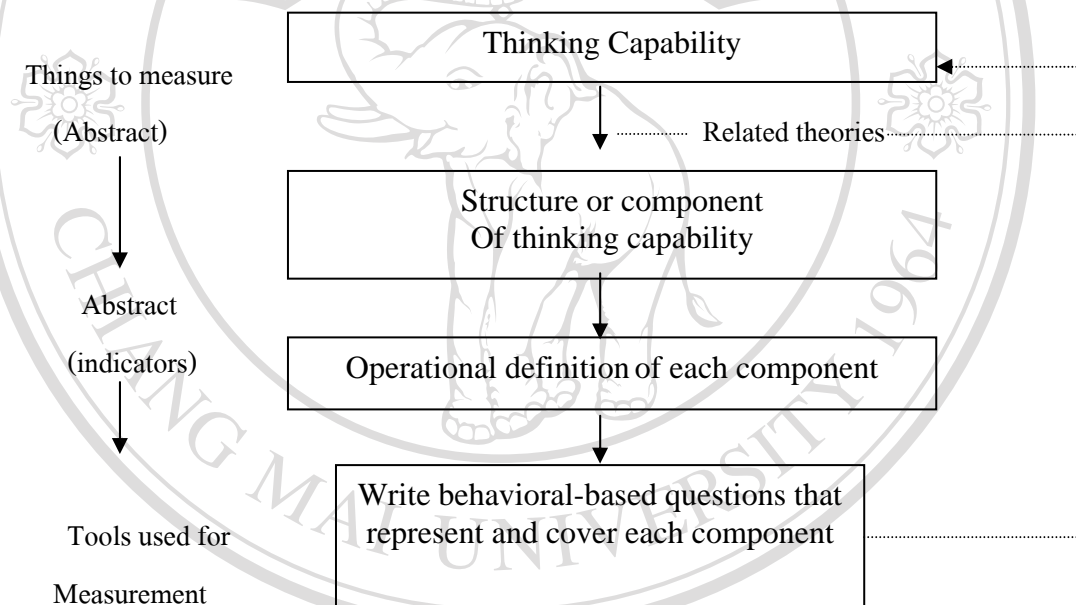
Diagram 1 The principle of creating the measurement test for the thinking abilities
Source: Tisana Khammanee et. al., 2001: 170–171.

2.2 The steps in developing the measurement test for Thinking Ability Test

In developing the thinking ability test, main important steps are as the followings (Tisana Khammanee et al, 2001: 170-171).

2.2.1 To identify the objectives of the measurement. The test builders must identify the objectives of creating

the thinking abilities tests. They also consider the purposes of using this thinking ability test, whether to measure the general thinking abilities or the thinking abilities in certain subjects (Aspect -Specific).   The measurement that aims to monitor the progress of the thinking abilities is called the Formative Test and the tests to evaluation the capacity to conclude or to summarize information are called the Summative Tests. For making decision including interpreting the outcome will be emphasize on the comparison of the group standard (Norm - Referenced) or want to compare the identified criteria or standard (Criterion - Referenced).

     2.2.2 To identify the frames of measurement and the operational definitions. The test developers should study the related theories about the thinking abilities according to the intended objectives and select them appropriately to the context. The main objectives are also selected in order to identify the proper structures or components on the thinking abilities according to the theories and the operational definitions of the components in terms of abstract behavior (indicating the characters of each thinking component).

     2.2.3 To create the "Test Blueprint" or to identify the frame of the measurement form on the thinking abilities that covers the structures or the components according to the relevant theories. The test builders also need to identify each part in terms of importance (in case they need to create the measurement form on thinking abilities in specific aspects). The contents of the subjects must be identified to see what contents are appropriate to be measured in the thinking abilities componets, including the ranks of importance of the content in each component of the thinking abilities as put in the "Test Blueprint" for further elaboration in the examination paper.

Necessary Components to be measured	Weight (%)	No. of questions (to measure abilities)
1. the abilities in considering the reliability of the data sources and observation results	25	10
2. abilities in inductive reasoning	25	10
3. ability in deductive reasoning	25	10
4. abilities in basic agreements/assumptions	25	10
Total	100	40

Table 1 The example of Test Blueprint of the measurement test/form on the thinking abilities

     Table 1 shows the "Test Blueprint" for measurement of general thinking abilities in four aspects. Each aspect has the equal weight of importance, which is 25 percent for each aspect (in this case, the test builders plan to create a measurement test with 100 questions). Therefore, each measured aspect will be assigned with 25 questions. But if the test builders want to create 40 questions for the whole set of test, each aspect will be assigned with 10 questions according to their importance. In identifying the length of the measurement test, the test builders should be aware about the consistency of the test length with the period test-taking as well as with the nature of the subjects to take the measurement test.

                    2.2.4 Writing the test form items, identifying the formats of the written items, the answers for the questions, and the scoring methods for different forms of items (the questions are set to be in real situation, problematic condition, data from article, reports and conversation in daily life, or free expression). For the format of the answers, it can take forms in summary or conclusions of the situation or problem in 3 to 5 summaries or conclusions that the subjects taking the test can decide the reliability or the possibility of the conclusions. For the scoring method, there should be scoring criteria such as 1 score for correct answer and 0 for inaccurate

or no answer. After identifying the general format for the set of measurement test, then the test builders can draft the test according to the identified "Test Blueprint" to complete all components. The language used also should follow the generally accepted model of test administration. Close attention, however, should be paid to the efficiency of the items to measure the targeted human abilities. The measurement test should avoid the leading questions and the questions that may embarrass the test-takers to pick the least embarrassing answer. After drafting the measurement test in the printed form, this draft should be reviewed first, for its appropriateness and the unambiguity of the language used, by the supervisors with high competency in creating the measurement test on student thinking abilities.

2.2.5 Testing the measurement test to administer to the real samples or similar groups to the samples and analyzing this trial's results for its quality in terms of measurement test format, its levels of difficulty (**p**) and item discrimination power (**r**) in order to select the most appropriate question items, levels of difficulty and discrimination power. The selection of the improved exam question items is done according to the "Test Blueprint" that the experts can check the whole test for content consistency the Reliability. The test items should have the reliability level at least at r= 0.50. Then the next analysis is taken to test the items' validity. If the other tests to measure the standardized test for thinking abilities (for comparison) can be found, then the test builders can calculate the coefficient value (or the concurrent validity) of the test being built.

The test builders administer the measurement test set after the item analysis of the test and quality analysis for the test forms suggest that the test form meets the level of test quality required. The measurement test on thinking abilities can be tried with the target groups. Everytime the measurement test is administered, the analysis for its levels of Reliability should be done before the results can be interpreted. The steps of developing the measurement test for thinking abilities can be summarized into the diagram as the followings.

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┌──────────────────────────────────────────────────────────┐
│  1) identify the objectives of the measurement form/test │
└──────────────────────────────────────────────────────────┘
                            ↓
┌──────────────────────────────────────────────────────────┐
│  2) identify the frame of measurement and operational definition │
└──────────────────────────────────────────────────────────┘
                            ↓
┌──────────────────────────────────────────────────────────┐
│              3) create the "Test Blueprint"              │
└──────────────────────────────────────────────────────────┘
                            ↓
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4) Written Measurement Test

| Identify the formats of questions, and answer and scorring | Drafted exam (including the correct answers and scoring methods) | Review of the drafted exam |

5) Administration of the measurement form to the samples

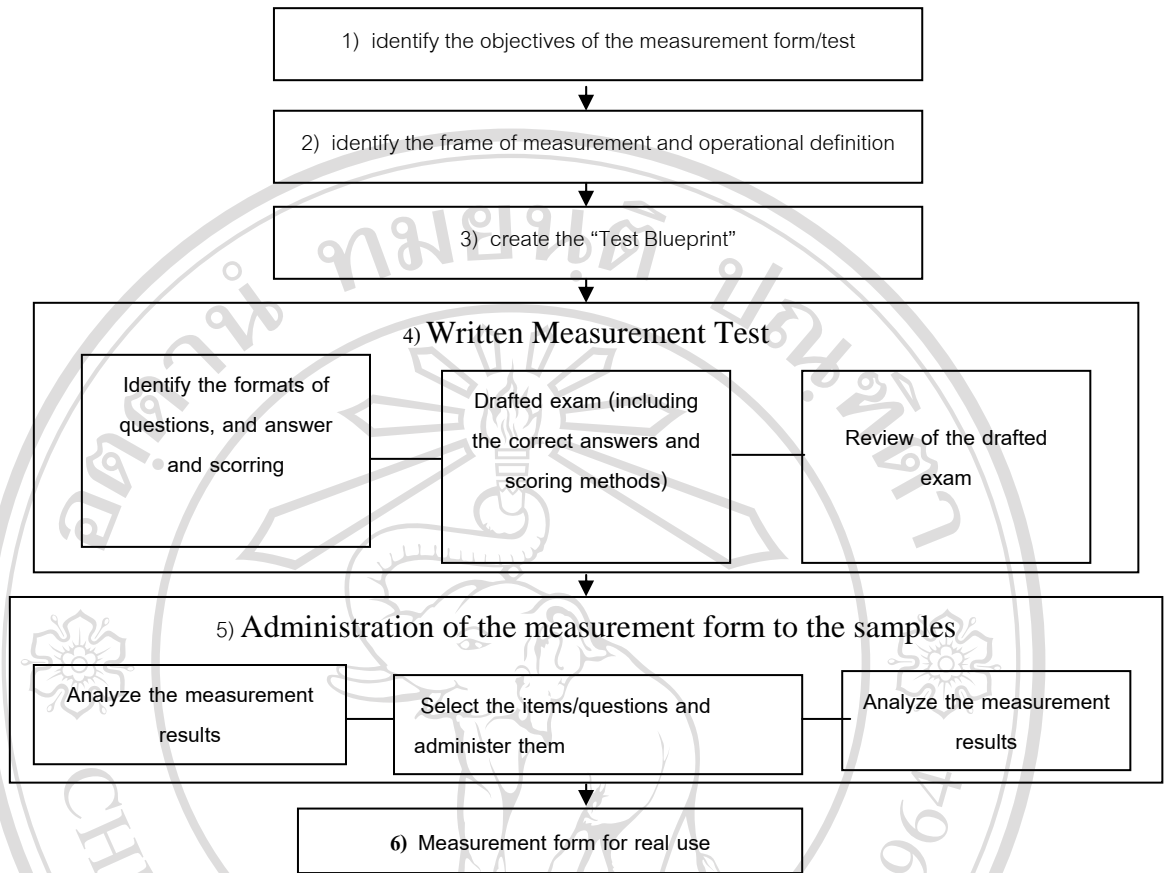| Analyze the measurement results | Select the items/questions and administer them | Analyze the measurement results |

6) Measurement form for real use

Diagram 2 Steps of developing the measurement form on thinking abilities (Tisana Khammanee et al, 2001: 170 - 171)

3. The measurement of the divergent thinking abilities

The builder of the measurement form must study the existing theories on the divergent thinking in order to know the structures or the components of such divergent thinking abilities that need to be measured. After the test builders identify the operational definitions of each kind of thinking, create the "Test Blueprint" for measuring the thinking abilities according to the frame of the operational definitions, and write the test items or the questions according to the identified "Test Blueprint". After the items or the questions are written according to the "Test Blueprint", the test builders try the test on the samples and collect the the scores of each aspect (to be used to interpret the norm-referenced or Criterion-Referenced results according to the appropriateness.

2. Arrangement of the Learning that Enchances the Thinking Skill

This study aims to study only on the teaching and learning aspects related to the teaching techniques, teachers' roles and student's roles, and the classroom climate that may enhance the thinking skill development. Such a subject of study directly influences the development of the thinking skills of the students. It can be summarized as follows:

2.1 Teaching techniques with enchancement of the thinking skills

Efficient thinking can not be built through short time but it requires certain methods to develop. The result of thinking processes can be expressed in terms of speaking, writing or body language, all of which can communite messages to others. The development of thinking abilities should use many techniques in order to improve the processes of brain development at full potential (Ministry of Education, 2005: 86). From the study of research about the patterns of learning arrangement on thinking process with the child-centered methods under Department of Curriculum and Instruction Development (2001: 7- 8), there are around 20 teaching methods which emphasize on the thinking process under Department of Curriculum and Instruction Development such as: (1) problem-solving process, (2) Learning and True Genius, (3) Quality-thinking Development Learning (focused on developing of thinking quality), (4) Constructivism Learning, (5) Teaching with Instructional Package, (6) Teaching Style in School by using Buddhism Technique, (7) 4MAT Learning Model, (8) Teneson's Teaching Method, (9) Gagne's Teaching Method, (10) Teaching using Skill Process, (11) Process-based Writing, (12) teaching by using projects, (13) teaching by using project work, (14) integrative learning, (15) Mastery Learning, (16) Center Learning (17) Inquiry Teaching Method, (18) Inductive Learning, (19) Deductive Learning, (20) Individualized Instruction or Self-Learning. Besides such teaching methods above, there is the teaching of Joyce and Weil (1980 cited in Department of Curriculum and Instruction Development, 2001: 24) that identifies six teaching methods which are Concept Learning, Advanced Concept Learning , Inductive Teaching Method, Inquiry Method, Jurisprudential Inquiry Technique and Synthetic Technique.

From the studies of the scholars about the style of learning and thinking process with the child-centered methods show that there are many learning arrangements. In this study, however, the researcher analyzes and selects the learning methods which are consistent with the principles of development of the thinking skills with child-centered. And then this study applies these principles to the arranged activities to develop the thinking skills through nine techniques, which are the Process Skill Technique, Concept Attainment Technique, Problem-solving Technique, Participatory Learning Technique, Jurisprudential Inquiry Technique, Synthetic Technique, Project Technique, Brain-storming Technique, and Critical Thinking Technique. These learning techniques are detailed as the followings.

2.1.1 Process Skill Technique

Process Skill Technique means working through all steps from the start until the whole work is done satisfactorily. Department of Curriculum and Instruction Development (1999: 40-42) proposes the nine teaching steps as the followings:

1) Awareness to the problems and the necessities. In this step the teachers give example of a situation that the students understand and be aware of the real problems or the benefits in the analyzing their solutions. The example case should reflect the problems or the conflicts by using interesting media.

2) The critical thinking. The teachers urge the students to think critically and answer the questions, means the training for students to express their opinions as individual and as group members.

3) Creation of various alternatives or solutions. The teachers allow the students to seek for their own alternate solutions. They help each other to think of the alternatives and discuss the positive and negative consequences of each alternative.

4) Evaluation and selection of the alternatives. The teachers allow the students to choose the alternatives for problem-solving by creating the criteria to consider on the factors, the implementation methods, the results, the limitation, the appropriateness and the right timing in order to use for selecting the problem solving. This procesion may require brainstorming method to discuss and additional study from various data sources.

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5) Identification and prioritization of the implementation. This step allows the students to make implementation plan of their own or of the group by prioritizing the implementation. This process involves the study of the basic data, the identification of the objectives, the identification of the implementation steps, the assignment of the responsible persons in case of group work, the identification of the working time, and the identification of the evaluation methods.

6) Practice with admiration. This step permits the students to voluntarily practice following the identified steps with willingness, intention, enthusiasm and enjoyment.

7) Evaluation during the implementation. This step allows the students to survey the problems and obstacles in the solution implementation by asking questions, discussing and exchanging opinions. There is an evaluation of the implementation following the steps and the executed plans. The conclusions of works in each period then begin the next step of work.

8) Improvement of the work. The students bring the results of the implementation in each period of evaluation to use them as guidelines for developing the work more efficiently.

9) Evaluation of the whole outcomes to build a "pride of achievement" among the students. The students summarize the implementation by making comparison between the actual results and the identified objectives (and other by-products). The results of the students' own works may spread as the works with pride.

2.1.2 Concept Attainment Technique

This teaching technique means the method to arrange the activities for the learners to cultivate the observation skills and ability to classify the differences and the similarities in order to get the conceptualization in their perception. Department of Curriculum and Instruction Development (1999: 42) propose five teaching methods, which are the followings.

1) Observation. This method would allow the students to perceive and study the data with the method by using media so that students are motivated to have self-directed learning.

2) Discrimination. This allows the students to tell the difference of perceived things and identify the reasons of the noted differences.

3)Common characteristics. This step allows the students to see the similarities of the whole picture of perceived things and produce conclusions based on methods, principles, and definitions.

4)Identification of the conceptualization (ระบุชื่อความคิดรวบยอด) This would train the students to propose the conceptualization of perceived things.

5) Test and application of knowledge to use. This step guides the students to experiment, test, observe, exercise and practice to evaluate and implement the acquired knowledge.

2.1.3 Problem-solving Technique

Problem-solving Technique means the teaching method that guides the learners to solve the problems progressive steps. Department of Curriculum and Instruction Development (1999: 44-45) proposes five teaching methods as the followings.

1) Observation. The teachers arrange the activities for the students to study the data in order to perceive and understand the problems until they can summarize the issues of problems.

2) Analysis. The teachers arrange the activities for the students to classify the problematic issues. They identify the causes and prioritize the rank of problems through discussions.

3) Creation of alternatives. The teachers arrange the activities and permit the students to seek for their own alternatives for various problems. There might be additional search or experiment in order to check and acquire data in details through the group work activities. Each group assigns the works to the group members and clarifies the work plans.

4) Collection of data to evaluate the alternatives. The teachers allow the students to perform according to the plan, record the performance, and check the correctness of the alternatives.

5) Conclusions. The teachers allow the students to synthesize their own acquired knowledge. It is produced from the knowledge gathered from solving the problems and it is presented by the students in the reports.

2.1.4 Participatory Leaning Technique

This technique integrates the experiential learning and the group process learning together and applies them in the learning contents. Office of National Education Commission (2000: 73-74) proposes the teaching methods as the followings:

1. Experience step. The teachers urge the students to bring their previous experience to develop the knowledge or develop the knowledge continuously.

2. Reflect and Discussion step. This is the set of arranged activities that stimulates the students to express and exchange their own opinions with those of others and learn from each other in group discussions.

3. Conceptualization step. The learners understand the conceptualization from the group works and discussions. Some of the studens may initiate the activities and then the teachers can add them up in varieties.

4. Experimental or Application step. The learners retrieve the acquired learning and apply it in real situation or in other conditions until it becomes part of the practice by the learners.

The relationship of all components in these four steps will be dynamic and may start from one point then move back and forth among the components. It may start in any point but the process arrangement must be all completed using all components. The teachers should design the work and the group for appropriateness to the activities, as well as designing the contents and the group processes in the implementation that the learning will be efficient.

2.1.5 Jurisprudential Inquiry Technique

Jurisprudential Inquiry Technique is a teaching method which allows the learners to solve the problems that occur out of the confusion the students may receive too much information and some of them contrast the other information. The learners can find their way out and gain the most benefit out of this trouble. At the same time this way out would cause little damage to the logical thinking processes.

Department of Curriculum and Instruction Development (1999: 35 - 36) proposes the teaching steps into six steps which are the followings.

       1. The teachers prepare the problems for the discussion and have many correct answers to the discussed problems. The teacher, however, must avoid the discussion on the religion issues, beliefs and culture of anyone in each group when presenting the problems to the learners.

       2. The students process the facts and tell what components, data, or values that related to one another.

       3. The students show their own point of views about solving the problems as well as the reasons for those views.

       4. The students try to understand their own point of views. The teachers set up questions to urge the students to think about those points of views.

       5. The students prepare more data from answering the questions posed by the teachers and they review their own points of views again.

       6. The students show the results of the reviews of their points of view or the changes in their points of view (also their reasons).

2.1.6 Synthetic Technique

Synthetic Technique is the teaching method that uses the stimulating method to urge the students to think about the guideline to solve the problems in different ways from those in the past. This method is using the comparison technique through which the researcher adjusts the comparison concepts in Synectic of Gordon (1986). The steps for this method are presented in the following five steps.

       1. The teachers explain the benefit and definition of the comparison thinking in Synectic that the learners become aware and perceive the necessity to train the use of the comparative thinking.

       2.The teachers explain the three comparative methods which are (1) Direct Analogy or direct comparison or comparison between the things being studied and their similarities, (2) Personal   Analogy or exposing the students' selves to be compared with the problems or things being studied that the learners understand better about the things under study in terms of facts, emotion and empathetic identification with a living thing, including the Empathetic Identification with a   non-living

objects, (3) the Fantasy Analogy or allowing the learners to imagine of a method to solve the problems or to perform the task to achieve the solutions. The teacher must give examples of words, things, persons, or problematic situation that the learners can understand their definitions and the comparative method using these three methods.

3. The teachers urge the learners to think and recall words or phrases and connect them together according to the comparative (analogy) method in each method. One method is tried until all three methods are completely used. During this training, the teachers should urge the learners to think freely and to express their own opinion openly without constraints or worries for giving wrong answers. When the learners give the recalled words or phrases, the teachers offer a feedback data if the words or phrases are well connected through the analogy or comparison. If the answer is yes, the teachers offer complimentary words and write those words on the blackboard. But if the answer is wrong, the teachers must give examples to stimulate the students to be able to think of the correct words analogy.

4. The teachers allow each student to practice the thinking exercise and bring two words or phrases to connect to one another as many as they can according to the analogy principle in each method then try to explain the definition in order to prepare to do next activity.

5. The teachers arrange the learners into three groups based on their interests that the members of each group can express their own opinion after the exercise in item 4 above. Then the teachers launch a brainstorming session to think of as many words or phrases as possible related to the assigned problem situation. Then at the same time each group explain the words' definitions and the thinking processes of the group. Group 1, for example, will provide Direct Analogy, and Group 2 will show Personal Analogy and Group 3 Fantasy Analogy. Afterward the representative of each group presents the group works in front of the classroom.

2.1.7 Project Technique

The learning arrangement in project technique is the teaching that aims to urge the learners to study the subjects of their own interests. The learners can set up the projects or plans to implement the activity by themselves and they have to perform and complete the tasks in the project under the supervision of an advisory teacher.

Department of Curriculum and Instruction Development (2001:27-28) presents some teaching steps for this method into four steps which are the followings.

1. Step to identify the objectives. In this step the teachers advise the learners to set up the obejctives of the learning.

2. Step to make a plan or a project. The learners individually or as group members make a plan, e.g. how to complete the plan, what methods to do the activities, etc.

3. Step to implement the plan. This is the step where the learners perform the activities or solve the problems as planned. The teachers support the students to perform, to think and to make decision on their own as much as possible and the teachers also advise the students how to measure their performance from time to time.

4. Step of evaluation of the results. The learners will be the evaluators of the activities or the projects whether they achieve the objectives or not, whether they commit mistakes or not, or how to improve any drawback.

2.1.8 Brain-storming Technique

Brain-storming Technique is the learning arrangement that enhances the learners to think in many ways in limited time. Everyone in the group can express their opinion freely. Osborn (cited in Department of Curriculum and Instruciton Development, 1999: 120) proposes the steps as the followings.

1. The participants will be about 10-15 students in the group and they sit in circle.

2. The head of the group presents the problems or issues which can be answered or commented in many angles.

3. The participants are urged to think of answers as many as they can without judging their answers (i.e. right or wrong, good or bad). The participants are not allowed to criticize other's opinions. Everybody must accept all opinions that the members in group have presented in the forum.

3. The participants take notes or record of the answers in order to be used as the guideline in thinking of other aspects or alternatives.

5.After the time for the implementation of activity is up(15–20 minutes) the groups categorize the gathered thoughts and opinions.

6. The members in the groups identify the criteria to evaluate all the recorded thoughts. If the group members accept in the group that the most valuable and creative problem solving methods have been found, the issue is thus settled. Then the forum brings forth other problems to brainstorming further.

2.1.9 Critical Thinking Technique

Teaching with the Critical Thinking Technique is the intellectual process to train the students to make decisions reasonably and carefully. Department of Curriculum and Instruction Development (1999:43) proposes the teaching steps for this method as the followings.

1.Observation. This allows the students to perceive the data in many ways that they can understand and build the conceptualization that connects all relevant things. The students can categorize all of the main ideas according to the data base.

2. Explanation. This allows the students to answer questions, to openly express their opinions on the identified subjects. This step emphasizes on the use of logic based on the criteria and refers to reliable supportive evidence.

3. Listening to the students' exchange of opinions and critiques based on logic and data without emotional outbursts or arrogance.

4. Make linkage or connection among subjects. This step allows the students to compare the differences and similarities of things or concepts. They categorize things of same kind under the same group and connect the things in term of causes and effects, as well as in term of comparison.

5.Criticizing is an activity arranged for the students to analyse the events, statements, concepts, and actions by classifying their strong and weak points, negative and positive parts, important or not important components by giving reason for the critique the students offer.

6. Making summary or conclusion. This is an activity arranged for the students to consider the components of action or data related to each other and summarize directly and correctly according to the database of classification.

2.2 Classroom climate that enhances the thinking skills

For the classroom climate which enchance the thinking skill, Aree Punmanee (2003: 108) proposes that this climate is the one with full of acceptance and stimulation for expression of opinions freely. This definition is consistent with the concept of Somsak Phuvipadawat (2001: 44-74) who states that classroom climate that enhances the creative thinking should promote and stimulate the interests and curiostity appropriate for children development in each period and their learning preferences. Besides, the things around the students also stimulate them to develop their own responsibilities in the knowledge seeking. The students should have chances to learn with the teachers, to learn in sub-group, or to work freely on their own. For the appropriate classroom climate, the educators should consider three aspects as the followings.

2.2.1 The Physical Climate such as the good decoration of the classroom (tidy, well-arranged tables and chairs). The teachers and students can arrange the tables and chairs for the learning in interesting or appropriate structure for the learning activities. Besides, the teachers and the learners can add the varieties in the physical climate by putting up the display board, arranging the students' work corner or a learning center in the classroom. In the arrangement for gaining such appaling climate, the teachers and students should spend too much time. The room arrangement can be rearranged slightly from time to time to pose values and challenges for the students to participate in their expression of opinions openly.

2.2.2 The Mental Climate is the creation of the learning activity milieus by the teachers. The activities arranged should urge the student to think in many forms such as to solve the problems, to find reasons, to think fluently, to think flexibly, to propose new lines of thought, and to think creatively. The teachers should encourage the learners to train themselves to think in divergent manners and to get rid of or reduce the obstacles or limitations to creative thinking. Besides, the teachers can arrange the activities outside the classroom in appropriate time to allow the students some times to think in games such riddle games, question games, etc. These enjoyable activites create in them some positive attitudes towards learning, towards friends and towards the classroom.

2.2.3 The Emotional Climate is the climate that imposes among the learners the feeling of values, power, sense of belonging to the group, self-respect, etc. After creating among the learners such positive feelings, the teachers should be broad-minded, build positive attitudes toward the students, listen to the students' problems, create the warmth among the students and feel comfortable to be with the teachers. Consequently the learners become open to think and free to act positively.

The studies on such concept can be applied to create the appealing classroom climate. The teachers create the warm, friendly, and fliexible climate to teach the students. The teachers should also arrange the physical climate through arrangement of the tables, chairs, learning corners and boards (to show student's works). These arrangements are appropriated to the interests of the learners and should allow the students to take part in the learning planning and implementation together.

2.3 Teacher's and students' roles to enhance the thinking skills

Arranging the learning in order to develop the thinking skill will be enhanced through the cooperation from many sectors such as from parents and the community members to develop the students to their full potentials. The roles of the relevant sectors such as the teachers and the students are as the followings.

2.3.1 Teacher's roles to promote the thinking skills. In presenting the concept on the teachers' roles in enhancing the thinking, Aree Rangsinan (1985: 103-104) stated that the teachers are responsible to teach the young learners to have proper behavioral transformation on their knowledge, opinion (thought), feeling, mind and attitude, including the changes on behaving themselves in appropriate manner in the society. And Aree Rangsinan (1985) presents the teacher's roles on the learning arrangement as to enhance the creative thinking that the students are encouraged to learn on their own, to observe, to make inquiry and to listen attentively to their own questions. This is tantamount to say that the children's opinions are valuable. This assertion should encourage the teachers to promote their students to show initiative to study, to learn from discovery, to show creative personalities through encouragement of their curiosity and practice-by-doing, to promote the students to be successful, to get ride of their fear and aggressive traits, and to create confidence and secured children. In addition, Aree Rangsinan (1985: 93–94) presents the opinions of the foreign

scholars about the teacher's roles in promoting the learners to have creative thinking that there should be an activity arrangement to develop the continuous creative thinking development both directly and indirectly. William (1971) argues the climate that encourages the learners to creatively think and act is the one that stimulates the creative thinking, but not the one that compares the child's performance with their friends or judges the child's performance using adult's criteria as the yardstick. (Miller, 1969) insists to convince the learners that all tasks of all learners are valuable because these tasks show each of their individually unique creative thinking. Miller (1969) quickly gives importance to all new thinking of all learners. He is patient enough to the misunderstanding and small mistakes of the learners which may occur naturally (Hillgard, 1973).

From the study of such concepts above, the knowledge can be brought to identify the teacher's roles to enhance the students' thinking skills; the teachers should have roles as the followings.

1. To study and select various activities and teaching techniques in terms of forms and kinds that may be appropriate to the learners as well as to develop the thinking skills for the learners continuously.

2. To be familiar with the students and to get rid of the students' fear by creating the feeling of secure and confidence to the learners and having flexibility to something uncertain or unclear.

3. To show respects to all learners' opinions with sincerity and to show the learners to appreciate the values of their own opinions and to support the learners to be self-confidence in heir own decision-making.

4. To encourage the students to present new and original opinions or ideas and to seek for various answers from the learners. When the students learn about certain questions, it is neither necessary to have only one answer to the question nor to get the answers only from the teachers, textbooks or encyclopedia. The learners can seek for the answers from various sources from the world.

5. To encourage the learners to study, to discover the new knowledge, and to create their own knowledge.

6. To give constructive critique to the learners, to give reinforcement to the learners such as criticizing in order to create open acceptance and improvement (not critique on personal matters), to give moral support, and to value highly those who rely on their own thinking and make their own decisions.

7. To be the Facilitator who arranges experience and learning media and assumes the roles as the presenter, observers, inquirer, reinforcer, advisor, provider of feedback data, climate arranger, system manager and evaluator that the learners can follow as the guideline for creating knowledge on their own.

2.3.2 The students' roles that enchances the thinking skills.

The studies about the concepts related to the roles of the students to enhance the thinking skills development show that there are certain documents about the indirect thinking development. The indirect thinking development represents the concept about the student's roles in the child-centered learning. This is the learning method that can enhance the students' capacity to improve their creative thinking skills efficiently through the synthesis of research work on the child-centered learning. Department of Curriculum and Instruction Development (2001: 7-8) proposes the student's roles in this aspect as the followings. (1) To participate in the learning activities by doing research, analyzing and implementing, and summarizing the knowledge on their own, 2) To have freedom in learning of their own interests and in developing their full potentials, 3) To express the learning behaviors such as intellects, interests, purposes, creativity, or applicability of the derived knowledge to be used in real life or new situation whenever possible.

From such concept above, Tisana Khammanee (1998, cited in Department of Curriculum and Instruction Development, 1999: 293- 294) propose the following concepts about the student's roles in the learning process with child-center learning. The students should have roles which are constructing the new knowledge by themselves (Construction), build the meaningful learning through the interaction with friends, teacher and others nearby people (Interaction), participate in physical activities (Physical Participation), and take part in social and emotional activities where they shared common feelings (Social Participation), actively learn the process

or the way to seek for knowledge (Process Product) and apply the knowledge to practical use (Application).

From the study about the role of the students in enhancing the thinking skills, this study can create the guideline to identify the roles of the learners to be able to develop the thinking skill among the students as the followings. The students can build the learning targets of their own, create positive attitudes towards learning, cultivate observation skills, love to make inquiry, show confidence in presenting their ideas, create the readiness (in terms of psychological, physical and time), participate in the learning by interacting with friends and teachers, have good sense of humor, learn happily, and able to apply knowledge in daily life.

3. Review of related Literature on Thinking Skills Development

After the analysis of the results on the thinking skill development, the researcher summarizes, arranges and presents the findings according to the types of thinking skill as the followings.

3.1 The review of related literature on analysis thinking development

From the research work of Preeyanuch Sathavoramanee (2004), it is known that the activity development in the enrichment curriculum can develop the analysis thinking skills of Prathom Suksa students. This development is possible through three principles on Individuality, Democracy and Practice integrated with the strategies of the students' involvement in three characteristics, e.g. freedom, opinion appearance and communication based on Astin's Theory of Student Involvement. After 10 kinds of activities are tried in a five-day overnight camp, the students' analytical thinking skills in five areas—Matching, Classifying, Error Analysis, Generalizing and Specifying according to Marzano's Taxonomy—were all increasing at the probability level of $P<.001$. The Means of the scores for the analytical thinking skills in the areas of Classifying and Error Analysis among the students with high or moderate score were higher than those of the students with low achievement (at $P<.05$). The research of Nipaporn Sangdee (1995) show that both the students who study the subject of Social Studies by using the four noble truths approach and those taught using the conventional instruction under teaching manual score a rather similar scores with no

statistical significance; But the average score of the group taught with the four noble truth is higher than the control group (conventional instruction). In addition to this study, there is a comparative study on the thinking skills development with different methods. Rapin Krammee's (2001) study entitled A Study of Mathayom Suksa I students Achievement and Analytical Reasoning Ability in Social Studies through Constructivism and Problem Solving Method reveals a finding showing that the analytical thinking abilities of the students trained specially and the control group (no training) are different with statistical significance level at P<.01.

The review of literature on the analytical thinking development shows that the analytical skills is the skill which can be developed not only among the learners in Prathom Suksa and Mathayom Suksa levels but also can be developed in both the content-based learning (ordinary curriculum) and the enrichment curriculum.

3.2 Review of related literature on synthesis-type thinking development

After studying the development of synthesis-type thinking and its correlation with the optimism among Mathayom Suksa students at grade level 3 in Bangkok Educational Service Area Office 3, Sumalee Puachoo (2004) shows that the levels of abilities in synthesis-type thinking among the students at Mathayom Suksa 1, 2 and 3 are not distinctly different. The female students, however, show higher synthesis-type thinking abilities than the male students. And interestingly the students who show the low, moderate and high levels of reasoning or logics are also showing rather similar synthesis-type thinking abilities (from the low to high levels). In addition, the findings show that the variable of class level appears to affect the students' skills in logics and the synthesis-type thinking abilities. But there is no clear correlation together with the other variables. The level of optimism among the students of Mathayom Suksa 1, 2 and 3 are not different. However, the female students show higher levels of optimism than those of the male students. The findings show no correlation between the variable on class level and sex which together affect the levels of optimism. This present research is about the synthesis-type thinking development methods that are still not so much studied but can be shown that the synthesis-type thinking can be developed further.

3.3 Review of related literature on critical thinking development

Cruze's study (1971) analyzed the changes in the critical thinking by using the Discovery Teaching Method and the Teacher-Centered Instruction in the course of Sciences for Grade 6 students from Asian Teacher Institute in the University of Philippines. The findings show that the students' test scores from the Critical Thinking Test after they get some teaching increase with high statistical significance although the abilities in the Evaluation of Argument show no difference with statistical significance. The findings of Chanya Boonplong (1998), who studied the development of a model for the computer-assisted instruction lesson for teaching the subject of Critical Reading for lower secondary school students, show that the model for computer-assisted instruction lessons for teaching Critical Reading Course is consisted of five components: principles, objectives, contents, instructional processes, and evaluation. The instructional processes are specifically focused on direct approach, indirect approach, and metacognition. The results of using computer-assisted instruction lessons from statistical analysis of the pre-test and post-test score revealed the following results.

The post-test scores of all the samples with high, medium and low learning achievements were significantly higher than the pre-test scores (P <0.05). There were statistical significant differences between the Critical Reading post-test scores of the samples with different learning achievement levels at P<0.05.

For the research in the university level on critical thinking, such as the study of Yupadee Kanjana (2002) on the activity package to develop the critical thinking abilities for the Vocational Education Certificate students (first year) at Satun Technical College, Satun Province. The findings show that the scores for critical thinking abilities of the students who are taught by the teaching package to enhance the critical thinking is higher than those of the students who are taught with normal teaching (statistical significance at P< .05). The scores of the post-training critical thinking abilities of the students who are taught by the activity package to enhance the critical thinking is higher than those of pre-training (statistical significance at P<.05). The scores for the levels of critical thinking of the students who are taught in conventional teaching method show no difference in pre- and post-training tests.

Another study by Somchai Rattanathongkom (2002) entitled "The Development of An Instructional Model with the Emphasis on Critical Thinking Processes for Physical Therapy Students, Khon Kaen University" found that the teaching model with emphasis on the critical thinking processes for the physical theraphy students is composed of eight components. These components can improve the critical thinking process and cerate the knowledge in the subject contents. For the evaluation of the model's teching efficiency, the experimental group who are taught by the model with the Emphasis on Critical Thinking Processes reach higher average score on the critical thinking (post-training test) than that of the students who are taught in conventional teaching (statistical significance at P<.05). The average score of the experimental group is higher than the accepted criteria (set at 60 percent).

From these studies, this study can conclude that the critical thinking skill is an important skill for leading life of a person and this thinking skill can be developed in the children at Prathom Suksa level, Mathayom Suksa Level and University level. To create a proper critical thinking skill measurement test, the test makers should compose it with several sub-test forms that the test can cover all components of the principle of the measurement of the critical thinking ability.

3.4 Review of related literature on creative thinking skill development

Now there are many studies appear on the creative thinking skills because this skill is necessary for living life in the contemporary world. Therefore there are many studies and promotional attempts to develop the creative thinking skill from kindergarten to the learners of all levels. For example, Patama Patrangkura's (1991) study on "Result of the Usage of Training Package for Parents to Develop Preschool Children Creativity" takes its sample from the parents (from 18 households with purposive sampling) of the children at the age of four and six months to six who are learning at The Project to Train the Creative Thinking for the Beloved Children. The findings show that the creative thinking development on the initiation (initiatives), fluency thinking and elaborated thinking of the pre-school children who are trained by the training package (for parents to develop the pre-school children creativity) is higher after the training (statistical significance at P< .01). In addition, the study entitled "The Development of Creative Thinking of Prathom Suksa 5 Students

Learning Art Education by Brainstorming Technique" by Wirat Kumcome (1991) shows that the students' creative thinking scores in all aspects after Learning Art Education by Brainstorming Technique are higher than their scores before taking this learning. Similarly, the study of Yupin Vilai (2001) entitled "The Effects of Drawing and Listening to the Story Programs on the Development of Prathomsuksa Two Students Creative Thinking" shows that the students who receive "Drawing Program and the student who received "Listening to the Story Programs" not only have higher creativity scores than their scores before the test (statistical significance at P< .05) but also higher creativity than the control group (statistical significance at P<.05). After the experiment, the students who received the "Drawing Program" and those who got "Listening to the Story Programs" have rather similar levels of creativity. These research findings show that the development of the creative thinking skills can be inserted in the learning activities in kindergarten (pre-school) and Prathom Suksa levels. The example for the research for the development the creative thinking at the university level is provided by Nirat Soodsang's study (2001) about the Effects of Synectic Activities in Multimedia Lessons in Developing Creative Thinking and Creative Products in Industrial Design Course for Undergraduate Students. The findings of Nirat Soodsang show that (1) there is certain correlation between the scores of the creative thinking and those of the creative product. The students' scores after completing all multimedia lessons are significantly higher than the scores before they taking the lessons (statistical significance at P< .05), (2) there is no correlation appears between the creative thinking and the creative products among the undergraduates students who learned the synectic activities in multimedia lessons, and (3) there is a positive correlation between the scores of the creative thinking and creative product after the samples learn multimedia lessons with four synectic activities (statistical significance at P< .05).

The studies of many researchers reveal that the creative thinking skills have a positive correlation with the achievements, and the creative thinking skill development can be applied in all ages, sexes and in various subjects. The researchers can create the development of the creative thinking by inserting the learning contents or creating the special training programs, which can be used for many learning

sessions such as telling/listening to stories, games or problem-solvings. The measurement of creative thinking abilities can be undertaken from the products and the problem-solving processes shown by the learners.

3.5 Results of developing the metacognitive thinking

The metacognitive thinking is the process that starts from planning, self-directed performing of the tasks according to the plan, until the evaluation of the implementation. Therefore the learners must have skills to control themselves. The development the metacognitive thinking skills at level beyond the Mathayom Suksa is exemplified by Wattanaporn Rangabtook (1992) who takes a comparative study on the efficiency between the metacognitive strategy learning on reading English performance of Senior High school with direct method and inserted in the learning content (indirect method). The students are divided into 2 groups. One group of sample is trained with the metacognitive strategy learning in reading English in direct method while the other group is taught with the metacognitive stategy in indirect method (inserted in the learning contents). The comparison shows that after the training, both groups of students have average scores on the awareness on metacognitive strategy learning on English reading performance better than the set criteria. These three criteria are (1) after the training, the average score in both groups increase higher than before the training of at least 15 percent of the full score, (2) after the training, the average scores of both groups are at least 60 percen of the full score, (3) after the training, the average score of both groups increase with statistical significance. It is shown that after the training, the students from both groups gain rather similar average scores on the awareness about the learning strategy of metacognition in reading. The average score on the "understanding of English reading" after the training of both groups show differences with statistical significance (P<.01). This data shows that the scores of the samples who are trained with the metacognitive learning strategy on reading performance are higher than the scores of the samples who are trained with indirect learning strategy on reading (inserted in the learning contents). Besides, the research shows that the metacognitive strategy can improve the students' performance in reading English texts. Jinda Koocharoen (2001) studies the training with metacognitive strategy to enhance the students' English-listening ability and their

better perusal of the metacognitive strategy. The findings show that the students' capability in English-listening after the training is higher than the capability before the training with statistical significance at of P<.01. This finding is consistent with the finding of a research that uses metacognition to self-regulation in learning (the research of Navarat Hussadee in 2001). Navarat Hussadee (2001) studies the Effects of Metacognition Training upon Self-regulation in Learning of Students in Special Education Program of the Chulalongkorn University Demonstration School, and reveals that the students who learn self-regulation by using the metacognitive training self-regulation gain the post-test scores higher than those of the pre-training test.

The studies cited above show that most of the researchers studying metacognition to train the students have taken their samples from the Mathayom Suksa and university levels. None of these researchers launch their studies of the use of metacognition to train the Prathom Suksa students. Therefore, it is obvious that there must be something related to the usage of the strategy of metacognition. The metacognitive strategy must train the learners to create awareness and self-regulation, which may not acceptable with the level of mental development of the Prathom Suksa students. Nevertheless, the research findings show that the usage of metacognitive strategy can be developed by creating the direct training program or the program that is inserted in the main learning contents. The metacognition can develop the learners on listening, reading and self-regulating, which can be correlated with the thinking skill levels of the persons trained.

3.6 Related literature on development the other types of thinking skills

Piyarat Khanthap's study (2002) entitled "The Teaching Model to Enhance the Higher-Order Thinking Skill by Using Webquest Instructional Process in Elementary Education: Case Study of Kesinee International School" is conducted in three phases. Phase one is related to the development of the model. Phase Two is the verification and improvement of the model by action research. Then Phase Three is the examination of the impact of the model on the students' development in the Higher Order Thinking skills, learning achievement in the subject contents, and the computer skills. The findings of the study reveal the model of teaching that may develop the students' Higher Order Thinking skills, learning achievement in the subject contents

and the computer skills. The details of each of the main components, e.g. Syntax, Social System, Principle of Reaction and Support System are also provided in the developed model. In the assessment of the use of the model (the post-training score of the Cornell Critical Thinking Test), the learning achievement in the subject contents and the computer skills are higher than the pre-training scores (statistical significance at $P<.01$.) The study above suggests that the thinking skill ability has a Positive Correlation with the achievement in the learning contents and the computer skills. In addition the research findings also show that the development of Higher Order Thinking skill can be developed at the young age or at Prathom Suksa level. This finding confirms the research finding of Office of National Education Commission (2001) that studies the Talented Children in Prathom Suksa (The Education Arrangement for Talented People on Higher Order Thinking Skill). The findings show that the creative thinking of the talented children at Prathom Suksa 3 who receive the training on Higher Order Thinking through the activity arrangement program to enhance this skill score higher in post-training test than the score in pre-training test (statistical significance at $P< .001$). Many researchers analyzing the development of the reasoning skill and Higher Order Thinking skill suggest that the program for the thinking skill development can be built in direct and indirectly (inserted in the main learning contents) methods. In addition, the thinking skill development can be done in pre-school (kindergarten) level, Prathom Suksa level, university level, and among the general public. The researcher should develop such training program appropriately to the samples taken and the research methods used.

From the studies above, this study may conclude that the thinking skills can be trained through the teaching method of the teaching programs, training sets or kits of learning activity, the teaching curriculum that is designed in proper way to the age of the learners, and the curriculum consistent with the steps in thinking skill training process in each type. The type of training on developing the thinking skills may take a form of direct teaching or indirect teaching (inserted in the learning contents). For the measurement test form on the thinking abilities, the study would design the test and the sub-test to cover the whole contents of the measured aspects. The measurement form should be created correctly according to the principles of measurement and evaluation.

From the study of textbooks, concept and theory, and the results of developing such concepts, this study suggests the use of the principles in the research as shown in Table 2. Also given is the framework of creating the learning activities for enhancing the thinking skill among the Mathayom Suksa 2 students under the Chiang Mai Education Service Area Office 2.

Table 2 Application of Concept and Theory to Create Learning Activity Mathayom Suksa 2 Students

Concept and theory, principle and reference source	Application to create the learning acivity plan
1. Children development on the thinking skill is divided into 4 steps. Step 4 identifies the children of 12 to15 can think logically and think about complicated and abstract subjects (Piaget, 1964).	Select the population and samples among Mathayom Suksa 2 students because they are at the age that can be trained to think in complicated and abstract terms.
2. Thinking is something that can be trained and should be developed for a period of time. The longer they are trained, the better the children can think (Schiever, 1991).	Consideration for the thinking skill training in 20 plans (each plan takes 60 minutes, twice a week). The researcher's experience in analytical skill training shows that the learners express their feedback opinion that 9 sessions of training is not enough.
3. The intellectual resources for success are composed of analytical thinking, creative thinking, and their application. Teachers should train the student who doing what, when, where, why and how. Then students compare, evaluate, judge, create, invent, imagine, pretend or manufacture, train to apply knowledge into real life, and train to give examples or illustrations (Sternberg, 1985). 4. Thinking is the ability to lead students to the right conclusions based on identified data. And they need to create the abstract thinking from the correlations within the problem situation. After that students check the conclusion's correctness and explain the conclusion in term of new thinking (Krulik and Rudnick, 1993).	1. Use the concepts to design the learning activities for the students to train their thinking skilld such as analyzing things or stories. Teachers give example of compared words or feeling of student's selves with living beings and non-living beings, train to conclude or summarize, train to imagine and create creativity from artificial clay, design imaginative products, write projects, and lead to actual implemention to solve environmental problems in school. 2. Design the activities by identify the situation or problematic situation for the students to think or to train them to show opinion as a person or as members of group in the concluding sessions. For example, this kind of activity takes place in Learning Units 4, 7, 8, 9, 11, 13, and 14.

Table 2 (Continued)

Concept and theory, principle and reference source	Application to create the learning activity plan
5. Teachers urge the learners to discover the inner reinforcement within the learners, motivate the students through curiosity, and think about things around themselves. Teachers should arrange the learning structure suitable for the age and the difficuty level according to the learners' intellectual development. Teachers should give feedback result in terms of correctness or inaccuracies, which are also self-reinforcement (Bruner, 1956).	1. Train the teachers to show the role of enhancing the thinking skills by giving verbal reinforcement, gestures, creative feedbacks, friendly climate to students to keep them feel secured. 2. Create the awareness to students by arranging the first orientation before the experiment for the students, e.g. the benefits, the student's roles to enhance the thinking skill such as observation skill and confident expression of opinion. 3. Arrange the order of activities in the learning activity plan Units 1 to 20 from easy to difficult one.
6. There are important learning components such as the learning results from human capability, learning processes, and memories as results of keeping data in the human brain, and the outside events affecting the learning in human body (Gagne, 1985).	Design the activities so that the students can learn from the practice from stimulus movement such as media from games, pretending roles, real objects, or news. The students can learn to perceive from senses such as ears, eyes, tongue, nose and body. These senses will stimulate the students to retain the stimulus movement inside their brain for long-term memory.
7. Critical thinking process has steps which are identifying the problems, analyzing of them, debating around the problems, asking and answering challenging questions, considering from the reliable data resources, observing and judgment over the data, making deductive reasoning (deducing from general facts to the more specific ones), concluding based on the data, evaluating the value, defining and evaluating the definition, identifying the assumptions and making decisions that lead to implementation and interaction with others (Ennis, 1985 and Dressel and Mayhew, 1975).	Use the concept to design the step of the training on critical thinking skills by identifying the situation or problems for the students to be trained to search for and try to understand the problems. Students select the data relevant to the problem, identify the assumptions, and conclude logically. Evaluation is made in order to make solid decision for implementation.

Table 2 (Continued)

Concept and theory, principle and reference source	Application to create the learning acivity plan
8. Creative thinking has four components: creative thinking, fluency, flexibility and elaborative thinking (Guilford, 1959). And the creative thinking process has five steps, which are searching for truth, seeking for problem, discovering the concepts and assumptions, seeking for answers to test the assumptions and accepting the results of finding to build new concept (Torrance, 1971). 9. Creative thinking process is composed of three steps: preparation, incubation and check or evaluation (Wallach, 1926). 10. Creative thinking process has seven steps, which are identify the problem, collect the data, analyze the data, utilize the concepts, think and clarify the results, synthesize and evaluate the whole process (Osborn, 1957). 11. The development of thinking skill enhancement through the brainstoming technique and acceptance of the opinion that different from others (Davis, 1991 and Rothwell and Kazanas, 1989)	1. Design the training activities to build creative thinking by using the training process in the steps, which are thinking fluently and thinking flexibly to categorize data into groups of same kinds. Intuitive thinking is built to produce many new original ideas which are valuable and elaborated in details. 2. Teachers arrange the activities for the students to prepare. They prepare to practice reflective thinking, analyze data, seek for data, synthesize all information, evaluate and check the thoughts such as done in the Learning Units 10 to 12. 3. Teachers consider select the brainstorming learning technique to use in the thinking training process.
12. The component of megacognitive thinking is the awareness of the strategy and the data resources necessary for the work as well as to know what to do and know how to self-direct to complete the tasks (Baker and Brown, 1984). 13. The components in metacognition are the knowledge and experience which a person has accumulated in long-term memory and send to the self-control and self-regulation (Flavell, 1985).	Identify the activities for the students to train to make plan, identify work's objectives, select the implementation methods which lead to objectives/work targets, arrange the order of implementation steps, categorize the problem which may occur and find solutions, check the plan, self-regulate the students' own and the group members' duties according to the plan, and train to evaluate for improvement.

1. Principles →

* Principles of thinking of Schiever (1991), Smith (1988), Sternberg (1985), Krulik and Rudnic(1993)

* Learning theories and intellectual development theories of Piaget (1964), Bruner (1956), Gagne (1985), Gilford (1967)

* Concepts about skills on analytical thinking, synthesis-type thinking, critical thinking, creative thinking and metacognitive thinking

2. Objectives :
To develop thinking skills

3. Content: Contents on news or events in daily life

4. Activities
  1) Titles
  2) Objectives
  3) Methodology
  4) Evaluation
  5) Learning media
  6) Appendix : activity cards used for teaching sessions. Evaluation forms.

Methodology to arrange training activities on thinking skill development				
Analytical thinking	synthesis-type, Thinking	critical thinking,	creative thinking,	metacognitive thinking
1.identify things to analyze	1. identify topics or titles to be synthesized	1. seek for answers and try to understand the problems	1. think efficiently to cover large amount of data	1.identify objectives of the implementation
2. classify the Components of the thing to be analyzed	2.identify objectives	2.select the data relevant to the problems	2.flexible thinking in order to categorize the groups	2.select the methodology to achieve to the target
3.summarize the correlations between the Components of Thing to be analyzed	3.study the data which correlated to the objectives	3.identify assumptions	3.creative thinking to get new, original and valuable idea	3.arrange the implementation steps
4.make Conclusions then Present the Finding	4.arrange and select data	4.make summaries and conclusions logically	4.elaborative thinking to get the thoughts in details	4.categorize the problems that may occur and seek for their possible solution
	5.check the concepts or the things to synthesize for further improvement/ revision	5.evaluate information and conclusion for decision making for implementation		5.check the planning and self-direct students' selves to follow the plan
	6.bring new thing To application			6.evaluate the plan for further improvement/ revision

*Arrange the training steps to train analytical thinking skills according to the concept of Tisana Khammanee (2001) and Kriengsak Charoanwongsak (2003), Ministry of Education (2005)

* Training steps on analytical skills according to the concept of Chawan Paratkul (1977 and Kriengsak Charoenwongsak (2003)

*Steps of critical thinking skills according to Robert H. Ennis (1985), Dressel and Mayhew (1957)

*Steps on creative thinking of Guilford (1959), Torrance (1971), Wallach (1926), Osborn (1957), Davis (1991), Rothwell (1989) Ministry of Education (2548)

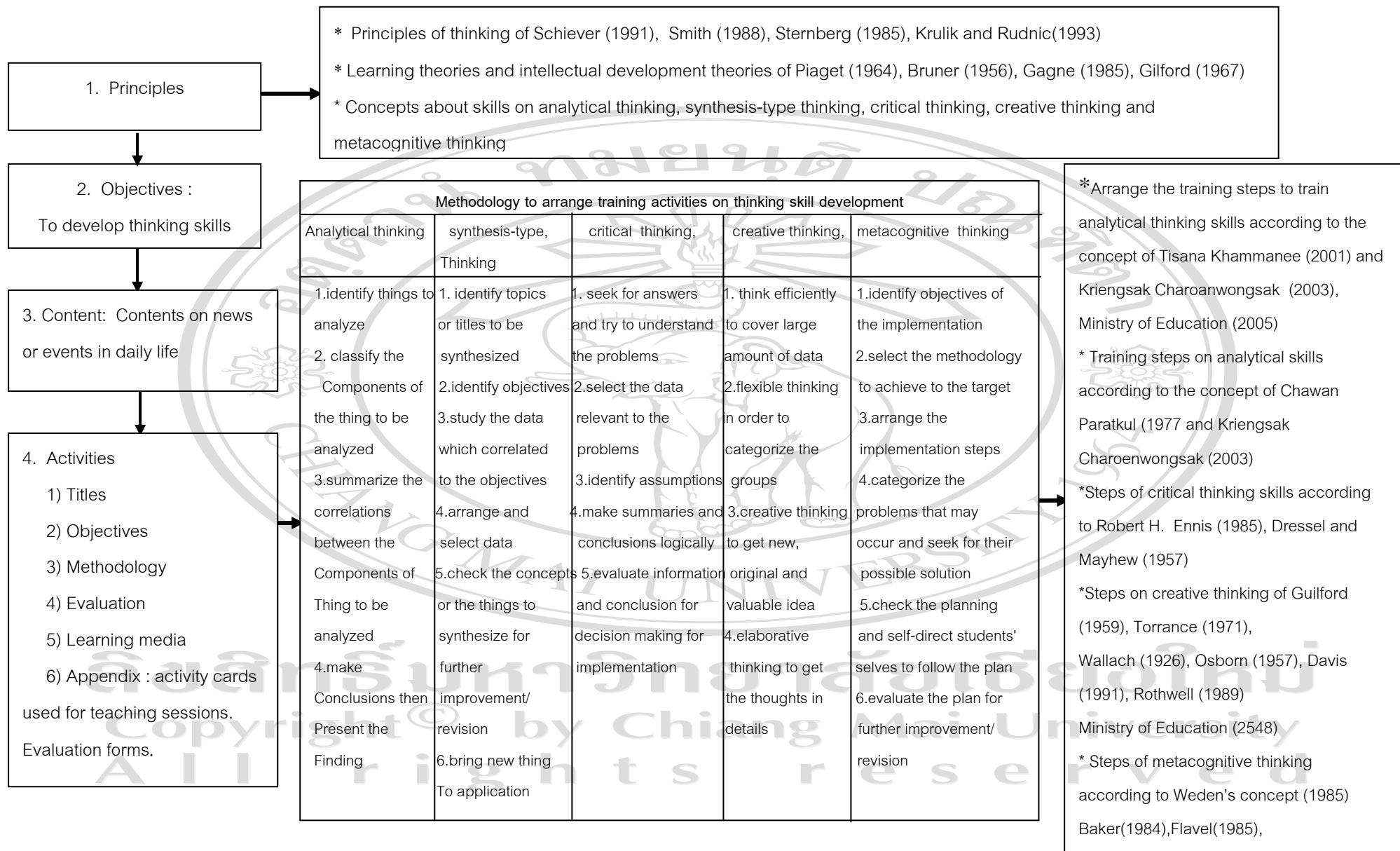* Steps of metacognitive thinking according to Weden's concept (1985) Baker(1984),Flavel(1985),

Diagram 3 (Original) Plan for Learning Activity to Promote Thinking Skill for Mathayom Suksa 2 Students in Schools under Chiang Mai Educational Service Area Office 2