

## **Analytical Thinking Development through Learning Model of the Tenth Grade Students**

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### **Abstract**

The purposes of this study were to 1) investigate factors of analytical thinking of the tenth grade students, 2) develop the analytical thinking learning model of the tenth grade students, and 3) compare analytical thinking of the tenth grade students through an analytical thinking learning model of the tenth grade students before and after experiment and between the experimental group and control group. The samples were students of the tenth grade at Buakhao School, Kuchinarai district, Kalasin province, obtained through cluster random sampling technique, divided into an experimental group comprised 44 students under classroom 4/3 and a control group under classroom 4/4 with 47 students.

The instruments employed for research were 1) the analytical thinking factors test consisted of four-multiple choices, 50 questions, 2) the semi- structured interview and assessment forms for experts, and 3) the analytical thinking learning model of the tenth grade students and the analytical thinking test consisted four-multiple choices, 40 questions. The data were analyzed by Percentage, Mean, Standard Deviation, Exploratory factor analysis, t-test dependent and t-test independent, respectively.

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The results of the study were as follows: 1) analytical thinking factors consisted of Matching, Classifying, Analyzing Errors, Generalizing and Specifying, 2) the analytical thinking learning model of the tenth grade students consisted of basic theory, principles, objectives, learning procedures, and assessment. The model was generally examined by specialists at the most level, and 3) the analytical thinking of the tenth grade students after being trained by the analytical thinking learning model of the tenth grade students was higher than before statistically significant difference at the .01 level and the analytical thinking of the experimental group was higher than that of the control group statistically significant difference at the level of .01.

**Keywords:** Learning model, analytical thinking

## Introduction

The analytical thinking is the significant basic thought skill for the other thinking skill. Then students who were trained until they have the expertise to use those skills would help them know the facts and the reasons over events happened and understand the background of the events. They also know that event should have some elements which make the fact and basic knowledge to use in solving problems decision or in decision-making assessment correctly. (Chareonwongsak, 2006: 1). Good analytic thinking should be characterized by sustained directed attention because solutions to analytic problems require focus on the problem elements (Ansburg and others, 2002: 1141-1152). It is corresponded Wichai Tansiri (2004: 227) notes that who has a good analytical thinking ability must be successful in every activity and every mission and can live happily in a society competition of knowledge over the advance of technology and information age - changes from the past society.

Analytical thinking is classified as a higher order thinking skill (Khemmani, 1997: 29 ; Borich, 2006: 20) which leads to other higher thinking level, such as critical thinking, decision making, problem solving and creative thinking, derived from the basic idea of synthesis. The thinking process of a person's behavior related to intelligence. In particular, the reasoning ability which is capable of logical thinking to conclude for a regulation from the situation given. (Sternberg, 1986: 70). In addition, the analytical thinking also enhances intelligence quotient (IQ), adversity quotient (AQ), decision making and summarize the various reasonable perceptions as to basic idea in other dimensions. Moreover analytical thinking contributes greatly benefit to individuals, organizations and country. In virtually all are required analytical thinking as a tool to study for knowledge and understanding. (Sariwat, 2006:

74). And the ability of analytical thinking, synthesis thinking, creative thinking, critical thinking and systemic thinking are to construct the house of knowledge or information in order to make decisions about themselves and society appropriately (Ministry of Education, 2006: 212).

However, the analytical thinking results under Thai education situation from several sources reported that the first decade of education reform in the past did not meet the goal of the learning reform, especially the features of thought were found in lower than the other skills (The Office of the Education Council, 2009: 21). It is related to the office of Basic Education Commission which is found the average compliance level of just 30-40%. The most important thing is that the population has of just 12% in thinking and creative skills. The approximately 63% just have thinking skill but do nothing another 25% do not think neither nor doing. It is also corresponded to the study of PISA (Program for International Students Assessment) had found that 74 percent of Thailand's illiterate reading, not know how to do analytical thinking and semantic analysis whenever they studied other subjects. And many teachers lack discovery in searching knowledge, reading, teaching method for their students in thinking system such as analytical thinking, synthesis thinking and critical thinking. (Office of the Education Council, 2013: 4)

Based on important issue and to solve those problems, therefore this study was to investigate how to solve the analytical thinking problems and attempt to develop analytical thinking learning model to improve analytical thinking effectively and appropriately for solving such problems. This study emphasized on the tenth grade students' analytical thinking ability because these students can develop their intelligence in the stage of concrete reasonable thinking. They also summarize general data with systemic reasons or can conclude those data even though that available data are not sufficient. It seems to be their ability to understand more complex languages. Their idea is associated to the intellectual students and imagination characters. This principle based on the theory of cognitive development of Piaget (1971: 12). Therefore in this study, the researcher has linked the process of social cognitive learning theory and cognitive Information Processing (CIP) which are consistent with the principles of learning either from the knowledge of the information, the mental procedures or the psychomotor procedures. As to purposes of education according to Marzano and Kendall's theory, the analytical thinking happens through the process of thinking such as the matching, classifying, analyzing errors, generalizing and specifying to be used as a theoretical framework for this research (Marzano and Kendall, 2007: 35).

## Objectives

1. To investigate factors of analytical thinking of the tenth grade students
2. To develop the analytical thinking learning model of the tenth grade students
3. To compare analytical thinking of the tenth grade students through an analytical thinking learning model of the tenth grade students before and after experiments and between the experimental group and control group

## Hypotheses

1. The analytical thinking of the tenth grade students after being trained by the analytical thinking learning model of the tenth grade students was higher than before training
2. The analytical thinking of the tenth grade students of the experimental group was higher than that of the control group

## Methodology

**Phase 1:** To investigate factors of analytical thinking of the tenth grade students

1.1 The population were the tenth grade students in 55 schools under the secondary educational service area office 24 and 12 schools under the Kalasin provincial administrative organization in academic year of 2014 with a number of 8,189 students. The samples were the tenth grade students at Buakhao School Kuchinarai district, Kalasin province in academic year of 2014 with a number of 403 students by cluster random sampling technique.

1.2 Research instrument used for data collection was the analytical thinking factors test consisted of four-multiple choices, 50 questions with the quality of each item ; difficulties ranging from .33 to .67, discriminative values ranging from .27 to .75, and the reliability of the total test was .75.

1.3 Data Analysis by using the exploratory factor analysis method and then rotation with Mainwaring Max (Varimax) method.

**Phase 2:** To develop the analytical thinking learning model of the tenth grade students

2.1 The target groups were stakeholders concerned in developing the learning model selected through the purposive sampling technique including 15 teachers of the tenth grade and 5 expert professors of the university.

2.2 Research instruments consisted of ; the semi- structured interview and assessment forms for experts

2.3 Data Collection by the use of the semi- structured interview comments on the condition and the need of the learning model from the stakeholders and experts

2.4 The methods used for data analysis consisted of ; Percentage, Mean, Standard deviation (S.D.) and Index of Item objective congruence (IOC).

**Phase 3:** To develop analytical thinking of the tenth grade students through the analytical thinking learning model of the tenth grade students

3.1 The population consisted of the tenth grade students at Buakhao School. Kuchinarai district, Kalasin province in academic year of 2014 with a number of 11 classes of 403 students.

The samples were the tenth grade students at Buakhao School, Kuchinarai district, Kalasin province in academic year of 2014 selected through cluster random sampling technique and classified to be an experimental group of 44 students in class 4/3 and a control group of 47 students in class 4/4.

3.2 Research Instruments in this Phase were the analytical thinking learning model of the tenth grade students and the analytical thinking test with 40 question items.

### 3.3 Data Collection

3.3.1 The experimental group and the control group did the pretest of the analytical thinking test simultaneously.

3.3.2 Treating on the analytical thinking learning model of the tenth grade students in 17 hours by the developed lesson plans.

3.3.3 The experimental group and the control group did the posttest of the analytical thinking test simultaneously.

### 3.4 Data Analysis

3.4.1 Comparison of the analytical thinking of the experimental group between pretest and post test through dependent samples t-test.

3.4.2 Comparison of the analytical thinking between the experimental group and control group through independent samples t-test.

## Results

**Phase 1** To explore factors of analytical thinking of the tenth grade students by means of factor analysis (EFA), and rotate the Mainwaring Max (Varimax) as shown in table 1.

**Table 1:** Factors weight, Eigen value, Percentage of variance. Percentage of Variability of component collection and Factors of analytical thinking of the tenth grade students

Factors of analytical thinking	Factors weight	Eigen value	Percentage of variance	Percentage of Variability Collection
Matching	0.335	1.804	36.084	36.084
Classifying	0.386	0.891	17.813	53.897
Analyzing Errors	0.441	0.843	16.866	70.763
Generalizing	0.312	0.740	14.794	85.557
Specifying	0.332	0.722	14.443	100.00

Table 1 showed that the five compositions of analytical thinking of the tenth grade students have the Eigen value more than 1 only matching element with the Eigen Value of 1.804. The percentage of variability collection accumulated is 36.084. And the other 4 factors of analytical thinking of the tenth grade students remaining the Eigen Value not less than .30 is considered the threshold as a factor of analytical thinking of the tenth grade students. This is concluded that the factors of analytical thinking of the tenth grade students consisted of 5 factors ; matching, classifying, analyzing errors, generalizing and specifying.

**Phase 2** To develop the analytical thinking learning model of the tenth grade students ; data collection by the use of the semi- structured interview comments on the condition and the need of the learning model from the stakeholders and experts were analyzed through descriptive analysis of the integration concept which consisted of the social cognitive learning theory and the cognitive information processing (CIP)). The analytical thinking learning model of the tenth grade students was evaluated by five experts in the most appropriate with an average of 4.70 and 1.111 of Standard Deviation (S.D). The developed model is found of the following elements.

The first element is principles. It means to learn by observing the model, acting out like models themselves and considering the values of the models' behavior pattern. Moreover they can learn by comparison with similarities and differences in the ways of analytical thinking and others thinking use. Learning the process of how to think of analytical steps, learning by trial phase analysis method and learning in a meaningful way can apply to use analytical thinking ability correctly.

The second component is objectives. This aims to develop analytical thinking of the tenth grade students and expand with the new knowledge including analytical thinking and applying.

The third element is learning process followed by the analytical thinking development through learning model of the tenth grade students as followings ;

- 1) Encouragement by informing the learning purposes, guiding students to know learning process by using observation approach and constructing interested stimulation that should be considered or paid attention,
- 2) Presentation by presenting the new contents with clarity in order, showing examples of action of which may be comics, movies, videos, television and publications, as well as stimulating or encouraging learners to pay attention to the lessons of the media,
- 3) Practice by giving the learners the necessary details from the unnecessary information and encouraging them to link the new information with what he or she knows,
- 4) Application by encouraging students to see the new perspectives on that subject, which is the application of knowledge that can be used in everyday life by learning how to compare the use of decision-making principles and practice discussion process,
- 5) Assessment is the stage where the learners must be evaluated in accordance with their respective analytical purposes and
- 6) Reinforcement is a step that the instructor gives students the ability to imitate correctly. Giving students the motivation is to support them to continue learning satisfyingly and to see if a student is able to act by imitation.

The fourth component is the evaluation form of the learning model. This evaluation is to assess students' analytical thinking through the five analytical thinking tests as followings ;

1. Matching is to measure and identify similarities and differences of the various information which related to a given situation.
2. Classifying is a measure of the sector by identifying things that came before - back. (Superordinate-subordinate Categories)
3. Analyzing Errors is to assess how to summarize in both the reasonable examples and new event of the information. And apply multiple skills to identify the error code of practicing situations.

4. Generalizing is a measure creating the new conclusions or principles through various types of knowledge, information or background knowledge.

5. Specifying is an evaluation of specifying reason only in logical consequences and prediction about what happened. And adjust various skills to construct summarization in different conclusions that will be happened under the given conditions.

**Phase 3** To develop analytical thinking of the tenth grade students through the analytical thinking learning model of the tenth grade students

3.1 To compare analytical thinking of the experimental group students of the tenth grade before and after experiment between pretest and posttest. Data were analyzed through statistical dependent Samples t-test with results displayed in Table 2.

**Table 2:** Comparing of analytical thinking with means and standard deviation of the experimental group students before and after experiments

Experimental Group	N	$\bar{X}$	S.D.	t	Sig.
Before	44	12.45	2.45	28.65	.000**
After	44	22.89	3.62		

Table 2 shows that the average analytical thinking of the experimental group after the experiment was higher than before at a statistically significant level. 01.

3.2 Comparison of analytical thinking score after the trial of the experimental group and the control group. Data were analyzed using statistical t-test and Independent Samples test. The results appear in Table 3.

**Table 3:** Comparing of the mean and standard deviation of analytical thinking after the experiments between experimental group and the control group.

Experiment	Groups	N	$\bar{X}$	S.D.	t	Sig.
After	Experimental Group	44	22.89	3.62	10.63	.000**
	Control Group	47	15.00	3.43		



Table 3 shows that the average analytical thinking of the experimental group after the experiment was higher than the control group at a statistically significant level .01.

## Discussion

The study of the analytical thinking of the tenth grade students through an analytical thinking learning model of the tenth grade students could be discussed findings as follows.

1. The factors of analytical thinking of the tenth grade students consisted of 5 factors ; matching, classifying, analyzing errors, generalizing and specifying, related to the criteria for components weighing from 0.3 up more elements ; (Ferguson and George, 1981: 141-146) including matching, classifying, analyzing errors, generalizing and specifying. This findings were also matched the concept of Marzazano and Kendall (2007: 37) mentioned that elements of analytical thinking expands the knowledge-based reasoning and the necessary analytical thinking should have more detailed information adequately. The analytical thinking has five components: 1) Matching is a process focused on pointing out the similarities and differences between the various elements of knowledge, the matching may have a simple form or sophisticated depending on the workload, 2) Classifying is to manage the knowledge that comes out to the kind of meaningful categories. The ability to classify things surroundings could help more understanding and being useful lifestyle to better, 3) Analyzing errors is to focus on logic or reason with any information or knowledge before being accepted. 4) Generalizing is to create a summing up of the information based on inference, inductive or deductive. And 5) Specifying is the application process to conclude or general principles to specific situations, so it looks as deductive rather than inductive addition. The findings are consistent and adhere to the concept of Chareonwongsak (2003: 26) mentioning that the elements of analytical thinking is knowledge and understanding of the subject to be analyzed. We will have to analyze the need to understand the basics of it. This knowledge will help to determine the scope of the analysis. Distribution and classification those are relevant to anything. It also related to Sternberg (2006: 321) revealing the effect of enhancing the ability to test SAT (Triarchic Abilities Test) of the higher secondary students by measuring the analytical thinking ability, adapting and creative skill as predictors of success in university studies. One conclusion is that students can use the component processes of the analytical thinking, assessments, decision making or comparing and pointing out differences affect to success in study.

2. The developed analytical thinking development through learning model of the tenth grade student consisted of the basic concept includes theoretical principles, objectives, learning process and evaluation. The developed model has been evaluated by experts with the most appropriate of 4.70. The results appear like this due to the researcher developed this model using the application and integration of concepts, theories, principles and combining with social cognitive learning theory (Bandura, 1976: 482) and the cognitive information processing (CIP) (Klausmeier, 1985: 376 ; Atkinson and Shiffrin, 1971: 89). The principle is to learn by observing students' behavior and their implementation, considering the values and the behavior pattern and learning by comparing the similarities and differences in the ways of thinking about how others think. Moreover students can learn the process of analytical thinking steps, learning by experimental analysis system method and learning by meaningful ways of analytical thinking process. In addition, the findings are consistent with the study of Srisa-ad (1998: 147) who developed the analytical thinking through learning model that created idea patterns by studying theory, concepts, principles and the models were already invented. It said that to achieve in good teaching, good quality and efficiency have to consider about how to conduct teaching, how many steps necessary to teach effectively, a composition or activity elements or activities could be subjected to review or scrutinize. Choosing with confidence necessary to achieve dramatic results should have an idea or theory and confirm findings and the results of the composition such activities.

3. Students developed analytical thinking through learning model of the tenth grade student have analytical thinking after the experiment higher than before the experiment at the statistical level of significance .01 and the experimental group has analytical thinking higher than the control group of statistical significance .01. This is because the sequel to the learning process of the model in six stages as follows:

3.1 Encouragement is the first step. Students start watching the video about 2-3 minutes, then do the activity "Do Now" in order to stimulate students' thinking for the opening to new content and to provide students with feedback from the past by means of a written or drawing. This is conformed to the conclusions of Maslow (1970: 109) concluded that children would be interested in anything then. Because of its experience and be familiar with it. Teachers should identify the purposes of learning to the learner in mind at all times. This is because the learning to develop analytical thinking necessary to motivate the learners first (Nisan, 1985: 3430-3434 ; Sternberg, 1986: 352).

3.2 Presentation is the second stage to view of the subject on the situation that previously then work together to analyze the image. The teachers use a variety of questions so students answered individually or in groups. The

teacher then explained the situation in Text 1 using images and events to offer a word or Phase, sentence, meaning that students did not know before, This make students understand the whole thing. These activities are related to the concept of Meier (1974: 371) and the conclusion of Sariwat (2006: 79) on the application of the theory of information processing intellectual (Information Processing). Trying to build a bridge that will allow students to connect between what students know before and something new by repetition (Rehearsal) collection (Organize) and expansion the thought (Elaborate). This is related to Joyce and Weil (2000: 134) developing teaching model to develop students' thought through the content provided. This leads students to learn how to think.

3.3 Practice is the work mode (during activity events). This is to make students understand the content or the given circumstances. Using thinking tools to encourage student thought. The idea is to train students to read individually by a given situation in all Text 1 again and Task 2 to obtain information. The student must provide a detailed summary of the situation, or whether the same or differences. Then the students trained to think in small groups. Students were divided into groups of 4-5 people to think in Task 3, and then compare results with their ideas of group members to determine whether the same or difference. This is consistent with the research of Yano (2553: 91) studied to synthesize research on a synthesis of research on instruction methods which affect analytical thinking of students on basic education level using meta-analysis technique. The research concluded that to learn how to deal with the events group collaboration and integrated impact analysis than teaching as usual. Moreover, this provides an opportunity for students to practice as a group. Because of the different conflicts of opinion will promote students to find out the information and would be adapted to new ideas (Johnson and Johnson, 1994: 178).

3.4 Application stage is to lead students' thinking to present the results thinking discussion of a subgroup to the larger group or and joint discussions between student to student or between students and teachers to have a conclusion. Then set the new situation for students to take the concept of practice to apply by imitate proper Task 4. Interacting with other children, help them to decrease to anchor at the self-centered because they are faced with opinions that differ from their own. This is to learn how to deal with different opinions and collaborate with other people in the developmental levels of each forum at the same time this make them improving to their own ideas (Dennis, 1990: 89). And group discussions affect to the development of the learners' thought (Takington, 1989: 129).

3.5 Assessment is to check the results of the monitoring activities "Do Now" and to individually thinking examine or evaluate the subgroup analysis of various aspects of the 5-10 items and teachers observe those students to follow the master activities at the same time.

3.6 Reinforcement is to indicate the results of the assessment of the various analytical thinking in Task 4. The teachers praise or reward those who score the highest score and to encourage those who have little or no evaluation criteria. For those who have not passed the evaluation criteria, teacher gives recommendations and assistance in the training of a further analysis.

## **Suggestion**

### **1. Suggestions for implication**

1.1 Teachers should take the factors of analytical thinking developed to be the tools for measuring analytical thinking of students and so on.

1.2 The results of this study will be helpful to the researchers that further analysis study. This means that the result of the research can be used to conduct the next research without having to repeat the analysis factors study again.

### **2. Suggestions for further research**

2.1 The study should carry on the comparison of analytical thinking ability in the different variances of the samples between gender, achievement and grade level.

2.2 Development analysis model is important, therefore the research should be continued to guide the development of analytical thinking of students more effectively in the future by guiding principles of the concept psychological theories to improve the quality of the tools. This will make research results so clear out and most helpful.

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