

# The Relationship Between Cognitive Styles and Critical Thinking of Undergraduate Students at Surindra Rajabhat University

Wijittra Potisarn<sup>\*1</sup> Prachit Intaganok<sup>\*\*2</sup> Nootjaree Boonget<sup>\*\*\*3</sup> and Udom Homkum<sup>\*\*\*\*4</sup>

*1,2,3,4 Information Communication and Technology for Education, Surindra Rajabhat University*

*E-mail: wijittrapo@srru.ac.th*

*Received: November 13, 2018 Revised: January 8, 2019 Accepted: January 25, 2019*

## Abstract

The objective of this research was to study the relationship between the cognitive styles and critical thinking of undergraduate students at Surindra Rajabhat University. The sample group was the first-year undergraduate students at Surindra Rajabhat University in the first semester of academic year 2018. There were 317 students which were collected by cluster random sampling. The instruments used in this research were a cognitive style test and a critical thinking ability test. The cognitive style test separated three styles of student thinking processes. These include an analytical style, a categorical style, and a relational style. The reliability of the cognitive style test yielded Cronbach's alpha coefficient of 0.709. Moreover, the critical thinking ability test could measure the levels of five critical thinking abilities namely inference making, recognition of assumptions, deduction, induction, and evaluation of arguments. The reliability of the critical thinking ability test was analyzed by the Lovett method at an 80 percent cut point which presented a score of 0.910. The data were analyzed by means, standard deviation, Pearson's correlation coefficient, and multiple regression analysis.

The results of the research were as follows:

The mean score of the critical thinking ability of students was 14.11 (S.D. = 2.473). The correlation coefficients of the variables found that the analytical style had a significant with the categorical style and the relational style but negative relationship at the .01 level. The categorical style had a significant with relational style but negative relationship at the .01 level. However, the correlation coefficients between cognitive styles and critical thinking showed that the analytical style and the categorical style had a significant with the critical thinking with a positive relationship at the .01 level while relational style had a significant with the critical thinking but had a negative relationship at the .01. Furthermore, the multiple regression influence from cognitive styles to critical thinking found that the three variables of cognitive styles that are important predictors of critical thinking gave a figure of 40.59%.

**Keywords:** Cognitive Styles, Critical Thinking, Relationship

## Introduction

Fifty years ago, it was enough to master the “Three Rs”; reading, writing, and arithmetic. However, the “Three Rs” simply aren’t enough. If today’s students want to complete in today’s global working society, they must also be proficient

in the “Four Cs” which are communicators, creators, critical thinkers, and collaborators (National Education Association 2018). These are called the “21<sup>st</sup> century skills”. This is an overarching description of the knowledge, skills,

and dispositions seen as prerequisites for success in the global workplace of the future (Germaine et al 2016). Nowadays, many studies on 21<sup>st</sup> century skills have been focused on the question “How do I teach the students to accomplish these skills?”. For example, the purpose of this research is to illustrate how each skill may be purposefully integrated into post-secondary teaching. (Germaine et al. 2016) Moreover, a perspective from England is a discussion of how 21<sup>st</sup> century skills are developed in early years, primary and secondary stages (White 2015).

However, the process of the cognitive styles contributed or related to the ability to think critically in accordance with the concept of dresses. (Pongdecha 1999). There are three styles of cognitive thinking processes based on the ideas of Kendall, Moss and Sigel which include descriptive - analytical style, categorical - inferential style and relational style. The cognitive style of people can present different types according to the situation or problem that has occurred. However, how to decide the cognitive style of each people was the observation of their thinking process. The thinking process which people presented the most, was the cognitive style. (Konlum 2002). From this reason, the cognitive styles could contribute or relate to the ability of critical thinking, making the study of cognitive styles of people very important.

Furthermore, teaching and learning to promote critical thinking skills is of more interest for educational researchers. There were many research and development topics of critical thinking skills such as using action research to develop critical thinking (Nold 2017), exploring cultural challenges and teaching methods to promote critical thinking of students at school (Tan 2017), or study the relationship between the critical thinking with different independent variables. The critical thinking process included

inference making, recognition of assumptions, deduction, induction and evaluation of arguments. The results of the research showed that the critical thinking process can predict English teachers' language learning beliefs and their respective levels (Dehghayedi and Bagheri, 2018). Moreover, it found that the study of promoting critical thinking skills was separated into two types of research methodology namely experimental research (Phengsawat: 2014) and survey research (Promwang 2010).

For this research, the survey research methodology was used at the study of the relationship between the cognitive styles and the critical thinking. The results of the study presented the fact that the cognitive styles can predict the critical thinking ability of the students. Moreover, it will lead to an improvement in the quality of teaching in developing critical thinking of students who have different cognitive styles.

### Research Objective

The objective of this research is to study the relationship between the cognitive styles and critical thinking of undergraduate students at Surindra Rajabhat University.

### Research methods

#### Population and Sample

1. The population were first-year undergraduate students at Surindra Rajabhat University. There were 1,526 students who enrolled in the first semester of 2018. (The office of academic promotion and registration 2018)

2. The sample was collected from the population using the Taro Yamane to calculate the sample size at a significance level of .01. There were 317 students who were collected by the cluster random sampling.

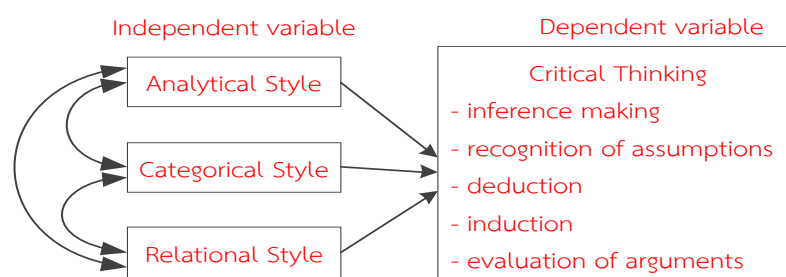
### Variables

1. The independent variable was the cognitive styles. There were three styles of student thinking process including analytical style, categorical style and relational style.

2. The dependent variable was the critical thinking. There were five levels of critical thinking abilities namely inference making, recognition of assumptions, deduction, induction and evaluation of arguments.

### Conceptual Framework

The study of the relationship between cognitive styles which include analytical style, categorical style and relational style all affected critical thinking abilities including inference making, recognition of assumptions, deduction, induction and evaluation of arguments. The concept of this research is shown in Figure 1.



**Figure 1** Conceptual Framework

### Theories

#### 1. Cognitive styles

The cognitive style was the pattern of the personal thinking process. The characteristics of individuals, or units of action, that make individuals express their perceptions. The thinking of people could affect people's representation such as personality, skills, abilities and learning behavior such as memory, understanding, implementation and problem solving. (Soreekul 2004)

Furthermore, the cognitive styles were personality traits of individuals who demonstrated perception and the individual thinking process. Firstly, thinking was more about perception than the process. Secondly, thinking influenced the personality of the person and thus was a dominant feature. Thirdly, the way of thinking is that of each individual. However, the cognitive styles can be changed according to age as people grow up.

Although the cognitive styles can change they do not change completely. (Witkin et al. 1971)

There are three styles of the student thinking processes. These included analytical style, categorical style and relational style. Each style can contribute or relate to the achievement of students. (Khumsawat 2006)

In summary, the cognitive styles refer to the characteristics and the abilities of each person's thinking. They are divided into three types of cognitive styles; analytical style, categorical style and relational style. A person can express the cognitive styles such as personality, skills and learning behaviors such as perception, memory, understanding, application and problem solving.

#### 2. Critical thinking

The critical thinking was the ability to use their own thinking in a thoughtful way. The thinking is based on information, evidence and their background knowledge which a person must link together leading them to make a decision by

reasonable settlement. (Pattiyathani et al. 2005)

The critical thinking also refers to the thinking or thought process, deliberation, judgment and information. In the conditions they appear by using knowledge or conditions. We used our knowledge, thoughts and experiences to carefully consider the evidence that leads to a reasonable conclusion. So to the process of tracking science which consists of the classification, interpretation, analysis, evaluation, conclusion and reasoning. These are the criteria for making a decision and evaluating the work. (Urairak 2010)

Moreover, the critical thinking means to reason effectively, recognizing connections between systems, concepts, and disciplines to solve problems and make decisions. Critical thinking requires clarity, accuracy, and precision of expression; relevance of arguments or questions; logic of thought; and thinking with sufficient depth and breadth to consider complexities and perspectives of an issue. (Germaine et al 2016).

In summary, the critical thinking refers to the level of individual competence used in thinking carefully and reasonably, with in the mind. When decision making in certain situations we must assess and summarize based on information, it must be backed up with evidence.

### Research Instrument

The instruments used in this research were a cognitive styles test and a critical thinking ability test. The steps to develop the instrument were as follows:

#### 1. The cognitive styles test.

The cognitive styles test was based on Kagan's concept. The question items included two illustrated pictures and three multiple choices. Each choice instead the cognitive styles including analytical style, categorical style, and relational style. The test included 40 items. Moreover, finding out the reliability of Cronbach's alpha coefficient yielded the value of 0.709. The

cognitive styles test was regarded as usable.

#### 2. The critical thinking ability test.

The critical thinking ability test was created according to the concept of Watson and Glaser (Watson and Glaser 2009). The test measured the levels of five critical thinking abilities namely inference making, recognition of assumptions, deduction, induction, and evaluation of arguments contained 30 items. Moreover, finding out the reliability of the Lovett method which set the cut point at 80 percent yielded the value of 0.910. The critical thinking ability test was regarded as usable.

### Data collection in research

1. Make a request to collect data in research.

2. The researcher used the cognitive styles test and critical thinking ability test to sample 317 students who were volunteers.

3. The researcher explained to the sample about the purpose of the research. The students had to do the test step by step. Firstly, they did the cognitive styles test. Secondly, they did critical thinking ability test.

4. Gather the tests for analysis.

5. Statistics utilized for analyzing the data were as follows.

5.1 Analyze the basic statistics were mean and standard deviation.

5.2 Analysis of the Pearson's correlation coefficient between the three styles of cognitive thinking were statistically significant. Moreover, analysis between cognitive styles and critical thinking scores were statistically significant.

5.3 Analyze the multiple regression which had influence from cognitive styles to critical thinking which are statistically significant.

## Data analysis

### 1. The result of mean and standard deviation

The mean of each variable came from the sample of 317 students. It was classified the

variable of cognitive styles including analytical style, categorical style, and relational style. Moreover, it showed the variable of critical thinking. The result is shown in Table 1.

**Table 1** The mean and standard deviation of the cognitive styles and the critical thinking (n = 317).

Variable	$\bar{X}$	S.D.
<b>Cognitive Styles</b>		
- Analytical Style	11.16	2.784
- Categorical Style	13.75	2.384
- Relational Style	15.09	2.394
<b>Critical Thinking</b>	14.11	2.473

According to Table 1, the symbols and abbreviations used in the data analysis represented by  $\bar{X}$  was mean, S.D. was the standard deviation. The result found that the students' cognitive styles mean ranked relational style at a higher level than other styles ( $\bar{X} = 15.09$ , S.D. = 2.394). The second ranked was the categorical style ( $\bar{X} = 13.75$ , S.D. = 2.384). Finally, the analytical style score less than other styles ( $\bar{X} = 11.16$ , S.D. = 2.784).

In addition, the mean score of critical thinking ability of students was 14.11 (S.D. = 2.473).

### 2. The results of the correlation coefficients of the variables

The Pearson's correlation coefficient between the three styles of cognitive thinking and the correlation coefficients between cognitive styles and critical thinking is shown in Table 2.

**Table 2** The Pearson's correlation coefficient of the variables

Variable	$X_1$	$X_2$	$X_3$	Y
Analytical Style ( $X_1$ )	1.0000	-0.5271**	-0.4049**	0.4095**
Categorical Style ( $X_2$ )		1.0000	-0.3590**	0.1920**
Relational Style ( $X_3$ )			1.0000	-0.5443**
Critical Thinking (Y)				1.0000

\*\* significance level of.01

Table 2, the symbols and abbreviations used in the data analysis represented by  $X_1$  was the analytical style,  $X_2$  was the categorical style,  $X_3$  was the relational style, Y was the critical thinking. The result shows that the analytical style ( $X_1$ ) had a significant with the categorical style ( $X_2$ ) and the relational style ( $X_3$ ) but a negative relationship at the .01 level. The categorical style ( $X_2$ ) had a significant with the relational style ( $X_3$ ) but a negative relationship at the .01 level.

However, the correlation coefficients between cognitive styles and critical thinking shows that the analytical style ( $X_1$ ) and the categorical

style ( $X_2$ ) had a significant with the critical thinking with a positive relationship at the .01 level while relational style ( $X_3$ ) had a significant with the critical thinking but a negative relationship at the .01.

### 3. The result of the multiple regression influence from cognitive styles to critical thinking

The results show the stepwise regression analysis using cognitive styles and critical thinking as in Table 3. Moreover, the result for predictability of cognitive styles to critical thinking is shown in Table 4.

**Table 3** The multiple regression between cognitive styles and critical thinking.

Source of Variance	Sum of Squares	df	Mean Square	F
Regression	957.8461	3	319.2820	71.2964**
Residual	1401.6870	313	4.4782	
R = 0.6371, $R^2$ = 0.4059,    SEE = 2.1162				

\*\* significance level of .01

**Table 4** The results for predictability of cognitive styles to critical thinking.

Variable	b	SE <sub>b</sub>	$\beta$	t
Analytical Style ( $X_1$ )	0.8028	0.1056	0.5880	7.6007**
Categorical Style ( $X_2$ )	0.6106	0.1029	0.4499	5.9363**
Relational Style ( $X_3$ )	-0.2082	0.1013	-0.1448	-2.0550**
a = -1.0488				

\*\* significance level of .01.

Table 3 and 4, the symbols and abbreviations used in the data analysis represented by was the standardized beta, b was the regression coefficient, SE<sub>b</sub> was the standard error for the unstandardized beta, t was the t test statistic, F was the F-distribution, R was the correlation coefficient,  $R^2$  was the coefficient of determination, and a was the constant.

As shown in Table 3, the results indicate that the cognitive styles are significant predictors of critical thinking:  $R^2 = 0.4059$ ,  $F = 71.2964$ ,  $p < .01$ . These results were supported by the close to moderate correlation between three variables ( $R=0.6371$ ). Approximately 40.59 % of the variance in critical thinking was accounted for by cognitive styles.

As shown in Table 4, when the results are analyzed, it shows that the three variables of cognitive styles that are important predictors of critical thinking can explain the percentage of 40.59%. According to the analysis results, the critical thinking of the students was predicted by the analytical style in the first rank, categorical style in the second rank, and relational style in the third rank. However, it found that critical thinking ability scores were effected by analytical style and categorical style with a positive relationship while relational style had a negative relationship. For example, a student who has a high score in analytical style will achieve a high score in their critical thinking ability, while a student who has a high score in relational style will get a low score in their critical thinking ability. Furthermore, it found that the model for a multiple linear regression was as follow:

$$Y = -1.0488 + 0.8028X_1 + 0.6106X_2 - 0.2082X_3$$

## Conclusion

This research aimed to study the relationship between the cognitive styles and critical thinking of undergraduate students at Surindra Rajabhat University. In summary, it found that the students' cognitive styles mean ranked the relational style in the first, the categorical style in the second, and the analytical style in the third. Moreover, it found that the critical thinking ability mean of students was 14.11 (47.03%).

The correlation coefficients of the variables found that the analytical style had a significant with the categorical style and the relational style but a negative relationship at the .01 level. The categorical style had a significant with the relational style but a negative relationship at the .01 level. However, the correlation coefficients between cognitive styles and critical thinking presented that the analytical style and

the categorical style had a significant with the critical thinking with a positive relationship at the .01 level while the relational style had a significant with the critical thinking but negative relationship at the .01.

Furthermore, the multiple regression influence from cognitive styles to critical thinking found that the three variables of cognitive styles that are important predictors of critical thinking can explain the figure of 40.59%. However, the analytical style and the categorical style had affected the critical thinking with a positive relationship while the relational style had affected the critical thinking but a negative relationship.

## Discussion

The study of critical thinking of undergraduate students at Surindra Rajabhat University showed the mean average of students' critical thinking ability was 14.11 (47.03%). Similarly, Hou (2018) showed that the students achieved overall critical thinking scores of 12.09 (40.30%). This percentage indicates that the critical thinking ability of students was lower than the passing grade of 50% (Wannaratn: 2017). Therefore, the students needed to improve their critical thinking ability as soon as possible (Sirisupluxana 2013). However, the study of the relationship between the cognitive styles and critical thinking of the students found that the cognitive styles had affected the critical thinking. Similarly, Pongdech (1999) revealed that the three types of cognitive style had a significant relationship with the critical thinking. Because of the three styles of thinking express the discriminative behavior, interpretation, analysis, evaluation, conclusion with appropriate reasoning which are needed for critical thinking. Similarly, Uairak (2010), Germaine et al. (2016), Pattiyathani et al. (2005), Khumsawat (2006) said about the people expression with critical thinking.

In addition, the importance of the cognitive styles that predict the critical thinking

ability can be seen as the analytical style and the categorical style had affected the critical thinking with a positive relationship while the relational style had affected the critical thinking but a negative relationship. Similarly, Pongdecha (1999) said that the categorical style and analytical style can predict the ability to critically think. Moreover, the students were not different on ability of analytical thinking and critical thinking (Rojaphot, 2012). However, this is not consistent with the research of Pongdecha (1999) because the relational style had not affected the critical thinking. As the research was of people of different ages, the cognitive styles of the people came from different ways such as internal data structure, personality, intelligence, attitude, and social behavior. Witkin et al. (1971), Cheewangkura (2010), Soreekul (2004), Prangson (2012), For this reason, the researchers or the educators should consider the cognitive styles of students before designing the learning activities to develop critical thinking or others skills.

### Recommendation

The mean score of critical thinking ability of undergraduate students at Surindra Rajabhat University was 14.11 (47.03%). It revealed that the percentage was lower than passing grade of 50%. The students need to improve their critical thinking ability because it is a prerequisite for success in the global workplace of the future. However, the learning activities should analyze the cognitive styles of students before studying because cognitive styles have the ability to predict critical thinking ability.

### Acknowledgement

First of all, I wish to thank you my advisors who guided and commented on this research.

Second of all, I want to thank you the experts who checked the quality of tools and helped me to make improvements. Last of all, I wish to thank you the students of Surindra Rajabhat University who volunteered in this research.

### References

- Cheewangkura, A. **A development of 4MAT methods for web-based instruction using learning objects upon learning achievement and logical thinking for secondary school students with different cognitive styles**. Doctoral dissertation, Department of Technical Education Technology, King Mongkut's University of Technology North Bangkok, 2010.
- Dehghayedi, M. and Bagheri, M.S. EFL Teachers' Learning and Teaching Beliefs: Does Critical Thinking Make a Difference? **International Journal of Instruction**, 11, 4 (2018): 223–240.
- Germaine, R., Richards, J., Koeller, M. Schubert-Irastorza, C. Purposeful Use of 21<sup>st</sup> Century Skills in Higher Education. **Journal of Research in Innovative Teaching**, 9 (1), 19 – 29. 2016.
- Hou, Y. Comparing Teacher- and Student-Focused Instruction on the Development of Critical Thinking Skills and Reading Comprehension. **International Journal of Literacies**, 25,1 (2018): 11–26.
- Khumsawat, D. **Factors of cognitive styles and critical thinking ability affecting learning achievement of Prathoom Suksa 6 Students**. Master's Thesis, Department of Research and Statistics in Education, Chiang Mai University, 2006.



- Konlum, S. **Effects of cognitive styles and feedback control in drill and practice in a computer-assisted instruction lesson on mathematics learning achievement of prathom suksa six students.** Master's Thesis, Department of Audio - Visual Communication, Chulalongkorn University, 2002.
- National Education Association. **Preparing 21<sup>st</sup> Century Students for a Global Society.** (online) 2018 (cited in 25 August 2018). Available from: <http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf>.
- Nold, H. Using Critical Thinking Teaching Methods to Increase Student Success: An Action Research Project. **International Journal of Teaching and Learning in Higher Education**, 29, 1 (2017):17 - 32.
- Pattiyathani, S., Chatsuwan, J. and Kumdee, W. Critical Thinking Test. **Journal of Educational Measurement Maha sarakham University**. 13 (September 2005): 1 - 15. 2005.
- Phengsawat, W. Experimental Research in Education. **SNRU Journal of Science and Technology**. 6(11) (January - June 2014), 181-190. 2014.
- Pongdech, D. **The relationship between cognitive styles and critical thinking ability of Prathomsuksa vi students.** Master's Thesis, Department of Educational Measurement. Thaksin University, 1999.
- Prangson, S. Cognitive Styles of teaching and learning. **Journal of Vocational and Technical Education**. 2,4 (July - December 2012): 4-13.
- Promwang, N. **Survey Research.** (Online) 2010 (Cite 2018 Aug 18). Available from: [https://rci2010.files.wordpress.com/2010/06/explore\\_research.pdf](https://rci2010.files.wordpress.com/2010/06/explore_research.pdf).
- Sirisupluxana, P. Teaching Nursing Students to Develop Critical Thinking Skills. **Journal of Boromarajonani College of Nursing**, 19(2) (July - December 2013): 5 - 19. 2013.
- Soreekul, N. **Effects of coaching in case-based learning on web upon problem solving of mathayom suksa one students with different cognitive styles.** Doctoral dissertation, Department of Curriculum Instructional and Educational Technology, Chulalongkorn University, 2004.
- Tan, C. Teaching critical thinking: Cultural challenges and strategies in Singapore. **British Educational Research Journal**, 43,5 (2017): 988-1002.
- The office of Academic Promotion and Registration. **The report of student summary in academic year 2018.** Surindra Rajabhat University. 2018.
- Urairak, P. **The Effects of Using the Research Processing Model Regarding Critical Thinking, Cognitive Inquiry, and Attitudes Toward Student Development Activities.** Doctoral dissertation, Department of Educational Research, Ramkhamhaeng University, 2010.
- Wannaratn, W. Test Score and Grading. **Journal of Humanities and Social Science, Rajapauk University**. 2, 3(October 2016 - January 2017): 1 - 11.
- Watson, G. and Glaser E.M. **Critical Thinking Appraisal – UK Edition.** (online) 2009 (cited in 26 December 2017). Available from: [https://us.talentlens.com/wp-content/uploads/pdf/WatsonGlaser\\_Short\\_Form\\_Manual.pdf](https://us.talentlens.com/wp-content/uploads/pdf/WatsonGlaser_Short_Form_Manual.pdf).
- White, J. 21<sup>st</sup> Century skills: a perspective from England. **E-Pedagogium**. 2 (April 2015): 51 - 61..

- Witkin, H.A., Oltman, P.K., and Karp, S. A. **A manual for the Embedded Figures Test.** Palo Alto, CA: Consulting Psychologists Press, 1971.
- Rojaphot, K., Tayraukham, S. and Chomeya, R. Comparisons of Ability to Analysis Thinking and Critical Thinking of Mahasarakham University Undergraduate Students a Gender Year and Study Group Different. **Journal of Educational Measurement Mahasarakham University**, 18, 1 (July 2012): 13 - 29.