

## THE RELIABILITY AND CONSTRUCT VALIDITY OF THE CRITICAL THINKING DISPOSITION SCALE

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### *Abstract*

*The Critical Thinking Disposition Scale guided by the literature of ways of knowing concept was applied for the first time in Thailand in 2013 on the study conducted by Poondej, Koul, and Sujivorakul but still needed to be validated. The purpose of the present study was to expand on previous finding by evaluating construct and factorial validity of the Critical Thinking Disposition Scale. This scale consisted of 20 items measuring the four-factor structure of a critical thinking disposition (cynical, analytical, empathic, and pluralistic disposition). The participants of this study were 488 undergraduate students in Thailand. To measure the internal consistency of the factors, we conducted reliability estimates. In terms of construct validity, confirmatory factor analysis (CFA) in Structural Equation Modeling (SEM) was used to test the validity. The results confirmed the validity of the four-factor structure of the Critical Thinking Disposition Scale which would be a useful tool for educators and scholars for measuring the tendencies toward particular patterns of thinking critically.*

Keywords: critical thinking; critical thinking disposition; construct validity; confirmatory factor analysis

Critical thinking is the ability to think clearly and rationally and focuses on deciding what to do or what to believe (Facione, 2000). It includes the ability to conceptualize, apply, analyze, synthesize, and/or evaluate the information gathered from observation, experience, reflection, reasoning, or communication (Valenzuela, Nieto, & Saiz, 2011). Therefore, critical thinking

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has always been viewed as a goal of academic work of all successful students (Stupnisky, Renaud, Daniels, Haynes, & Perry, 2008).

Educational researchers and theorists (e.g., Ennis, 1996; Halpern, 1998) posit that any conceptualization of critical thinking must include both skills (ability to interpret, analyze, and evaluate data, knowledge, and insight) and dispositions (tendency or willingness to use analytical thinking skills) (Bohlin, 2009; Facione, 1990; Perkins, Jay, & Tishman, 1993; Siegel, 1999). As the critical thinking is a mental process that connected to cognitive activity which is not activated automatically, it requires something to spur the activation. The disposition thinking, therefore, has been used as one that will activate and maintain the critical thinking process (Valenzuela et al., 2011). Furthermore, both cognitive skills and effective dispositions should be promoted (Giancarlo & Facione, 2001; Perkins et al., 1993) because it is not enough for individuals to have the skills of critical thinking if they are not inclined to use them.

#### *The concept of critical thinking disposition*

Throughout the literature, there has been the lack of a universally accepted definition and component of critical thinking disposition. Many concepts of critical thinking disposition have been proposed. For example, Beyer defined critical thinking disposition as a frame of mind and mental operations that includes alertness to the need to evaluate information, a willingness to test opinions, a desire to consider all viewpoints (Beyer, 1985). In the discussion of DeNitto and Strickland (1987) critical thinking dispositions included doubt, carefulness, objectivity, and determinism. Siegel (1988) also identified disposition to think critically as having a critical spirit that included intellectual honesty, impartiality, objectivity, justice to evidence, a commitment to seek and evaluate reasons. Associated with a good critical thinker, the conceptualization of the disposition toward critical thinking purposed by APA committee is one of the best that surfaced during the last quarter of the Twentieth Century. They conceptualized: 'critical thinking disposition' in a positive manifestation sense as characterized by truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, and maturity (Facione, 1990). Moreover, there are other attitudinal factors or intellectual and moral virtues that promote the thinking critically. Perkins, Jay and Tishman (1993) offered seven dispositions: (1) the disposition to be broad and adventurous, (2) the disposition toward sustained intellectual curiosity, (3)

the disposition to clarify and seek understanding, (4) the disposition to be planful and strategic, (5) the disposition to be intellectually careful, (6) the disposition to seek and evaluate reasons, and (7) the disposition to be metacognitive.

However, although there are varying concepts of components for critical thinking disposition, philosophers, psychologists and educators tend to identify similar sets, and the most common component of these dispositions are open-mindedness and looking for other points of view, curiosity, the disposition to seek and evaluate reasons, and objectivity (Beyer, 1985; DeNitto & Strickland, 1987; Ennis, 1985; Facione, 1990; Halpern, 1998; Perkins et al., 1993; Siegel, 1988).

#### *The instruments for measuring critical thinking dispositions*

There is no agreement on measuring critical thinking disposition, and not many instruments are designed for measuring critical thinking dispositions. The most widely known general critical thinking disposition test is the California Critical Thinking Disposition Inventory (CCTDI) developed by Facione and Facione (1992). The CCTDI based on the Delphi Report's consensus definition of critical thinker (Facione, 1990) focuses on the affective, attitudinal dimension. After factor and item analysis techniques, seven affective elements of the overall CCTDI were created as follows: (1) truth-seeking; (2) open-mindedness; (3) analyticity; (4) systematicity; (5) inquisitiveness; (6) self-confidence; and (7) maturity.

#### *Previous study on critical thinking disposition instrument*

Recently, in 2013, an instrument using the concept of personal epistemology as a measurement was applied in Poondej et al.'s study. Their instrument was a self-report tool guided by the literature of ways of knowing concept (Belenky, Clinchy, Goldberger, & Tarule, 1997). According to the literatures, 'separate' and 'connected' ways of knowing, two of actively constructive positions of ways of knowing in Belenky et al. (1997)'s finding, are types of cognitive style and epistemic positions that support critical thinking (Marrs & Benton, 2009; Schommer-Aikins & Easter, 2009). The *separate ways of knowing* stresses knowledge evaluation through objective, analytical, and formal logical argumentation. In contrast, the *connected ways of knowing* stresses the personal connection, empathy, and the effort to understand other's

perspective and the connected nature of knowledge (Koul, Clariana, Kongsuwan, & Suji-Vorakul, 2009; Sutton, Cafarelli, Lund, Schurdell, & Bichsel, 1996).

In Poondej et al. (2013)'s study, they used the exploratory factor analysis (EFA) procedure to identify the factor structure or model for a set of critical thinking disposition variables. Through the use of EFA, they have proposed that the critical thinking disposition factor can be further divided into cynical, analytical, empathic, and pluralistic thinking disposition subcomponents. *Cynical thinking disposition* is the tendency to evaluate and argue other's opinions by seeking and finding the holes as well as thinking of a different way of logic. *Analytical thinking disposition* is the tendency to consider opinions through logic and reason. *Empathic thinking disposition* is the tendency to recognize and share the feelings of others. *Pluralistic thinking disposition* is the tendency to seek diverse viewpoints or conceptual positions.

According to factor analysis techniques, EFA is typically used for an exploratory method to determine the appropriate factor structure or model. Confirmatory factor analysis (CFA) is theory- or hypothesis driven, which was widely used for purposes of examining construct validity of hypothesized relations among ordinal variables (Harrington, 2008). Although EFA and CFA are based on common factor model, each technique is appropriate in different situations. Researchers suggested that a line of research would start with EFA for factor structure development. The structure can then be evaluated with CFA to examine whether the original structure or model fits well in the new data (Brown, 2006; Gerbing & Hamilton, 1996; Haig, 2005; Hurley et al., 1997).

Therefore, to validate such Critical Thinking Disposition Scale (CTDS) applied the first time in the Thai context, we set up two primary goals in the current study. Firstly, to determine which model is the best representation of the data, we used the CFA technique to compare the relative strength between the two-factor model (separate and connected structure) proposed by the literature (Belenky et al., 1997) and the four-factor model (cynical, analytical, empathic, and pluralistic thinking disposition structure) initially established by the previous study (Poondej et al., 2013). Base on the factor extraction of EFA within factor analysis in Poondej et al.'s study which provided the factor pattern, we hypothesized that the four-factor model would be better in this study. Secondly, if the four-factor model was confirmed, we wished to introduce descriptive statistics for the CTDS and to build on the obtained

preliminary evidence for its validity. More specifically, the evidence for the construct validity of the CTDS will be replicated.

## **Method**

### *Participants*

The convenience sampling technique was employed in this study with 488 volunteer undergraduate students in Thailand. This number of sample (N=488) is more than the minimum recommended sample size (Kline, 2011). The age of the participants was between 18 and 20 years old (M=18.39; SD=.72). More than 98% of the responses to the survey were complete. Female students comprised the majority of the final sample for analysis (371 participants or 76%). In our sample, the composition of academic program was 40.0% social science, 5.3% health science, 16.2% humanities, 20.1% economics, and 18.4% nursing.

### *Instruments*

The instrument used in the study was the Critical Thinking Disposition Scale (CTDS) (Galotti, Clinchy, Ainsworth, Lavin, & Mansfield, 1999; Koul et al., 2009; Poondej et al., 2013) that assessed procedural knowing as a measure of critical thinking disposition. The first section of the instrument asked for general information (e.g. gender, academic major). The second section is the CTDS which consisted of 20 items (e.g., "I prefer to listen to the opinions of other people") and scored on a five-point Likert scale. The theoretical grounding for the CTDS was based on the 'ways of knowing', and used to guide the content of each survey item.

### *Procedure*

The CTDS was distributed to all participants in the sample. They were told that the questionnaire was anonymous, and all data were collected and conserved by the researchers. Participants completed the questionnaire in a classroom at the end of their midterm examination. Researchers were available during the data collection time in case participants may need more clarification. After all participants returned us the filled questionnaire, we then informed

them the purposes and scopes of the current investigation. The whole procedure took about 30 minutes.

### *Data analysis*

To assess the internal consistency reliability of the instrument, the coefficient Cronbach's alpha was performed. Alpha coefficient value above .70 was acceptable (Hatcher, 2013; Nunnally, 1978).

We used AMOS to conduct CFA to examine the construct validity of the CTDS with the Maximum likelihood estimation methods. The input for each analysis was the covariance matrix of the items. Following the establishment of each model structure, we examined several fit indices. Though set of fit indices, the most common measures were: (1) the chi-square ( $\chi^2$ ); (2) comparative fit index (CFI); (3) goodness of fit index (GFI); (4) normed fit index (NFI); and (5) rooting mean squared error of approximation (RMSEA). Chi-square test, the original fit index for structural models, is a test of difference between observed and expected covariance matrices. Non-significant values indicate that the hypothesized model fits the data. However, one problem with chi-square test of model fitting is that it is sensitive to the normality of the data and the sample size; it very readily reaches significance with large sample size (Barrett, 2007; Bollen, 2005; Tinsley & Brown, 2000). Due to these drawbacks of chi-square test, therefore, many alternative fit statistics have been considered.

The cutoff criteria for fit indexes were recommended by Baumgartner and Homburg (1996), and Hu and Bentler (1999). Normally, RMSEA, CFI, GFI, and NFI should range between 0 and 1. To indicate fitting between a model and the data, CFI and GFI values should be greater than .90, and .95 for NFI value. Ratio of change in chi-square to degrees of freedom ( $\chi^2/df$ ) should be at or less than to 2 or 3. RMSEA value of less than .06 is indicative of acceptance model fit.

According to hypothetical underlying constructs for the CTDS, two models were proposed to assess the best fit. Model 1 was a two-factor model with two latent factors ('connected ways of knowing' factor and 'separate ways of knowing' factor). Model 2 was a four-factor model which consisted of cynical, analytical, empathic, and pluralistic thinking disposition factor. When

comparing models, the assessments of the best fit models were based on the same fit indices and the same cutoff criteria for fit indexes.

Table 1. Descriptive statistics for outcome measures (N=488)

	Males		Females		Total	
	M	SD	M	SD	M	SD
Model 1 (two factors)						
• Separate	3.72	0.45	3.64	0.49	3.66	.48
• Connected	4.00	0.48	4.03	0.45	4.02	.46
Model 2 (four factors)						
• Cynical	3.52	0.56	3.41	0.63	3.43	.61
• Analytical	3.97	0.53	3.92	0.54	3.93	.53
• Empathic	4.05	0.59	4.07	0.49	4.07	.51
• Pluralistic	3.95	0.54	3.98	0.56	3.97	.56

## Results

A descriptive statistics (means and standard deviations) of CTDS were shown in Table 1. The reliability values (Cronbach's Alpha value) of the measure for 'connected' and 'separate' as sub-scales for two-factor model were .80 and .83, respectively. For four-factor model, the reliability values for 'cynical', 'analytical', 'empathic', and 'pluralistic' as sub-scales were .81, .82, .78 and .70, respectively.

After using the CFA technique with the observed data for the two latent factors (two-factor model), all fit index values indicated a relatively poor fit of a structural model. When we used CFA technique again with the next model (four-factor model), most fit index values demonstrated acceptable fit for the model. Although this model also had a statistically significant chi-square value, the relative  $\chi^2/df$  ratio indicated acceptable model fit and other fit indices also met the requirement of model fit (see Table 2).

Table 2. Goodness-of-Fit Indicators of Models (N=488)

Model	$\chi^2$	df	$\chi^2/df$	CFI	GFI	NFI	90% CI	RMSEA
Model 1 (two factors)	1133.822***	169	6.71	.702	.746	.669	.102, .114	.108

Table 2. Goodness-of-Fit Indicators of Models (N=488) - *continued*

Model	$\chi^2$	df	$\chi^2/df$	CFI	GFI	NFI	90% CI	RMSEA
Model 2 (four factors)	447.251***	164	2.73	.913	.913	.870	.053, .066	.060

Note: \*\*\* p<.001; CFI=comparative fit index; RMSEA=root-mean-square error of approximation; GFI=goodness of fit index; CI=confidence interval; NFI=normed fit index

According to the fit indices (Table 2), four-factor model was selected as the best fit for the observed data. Standardized parameter estimates for both models are provided in Figure 1 and 2.

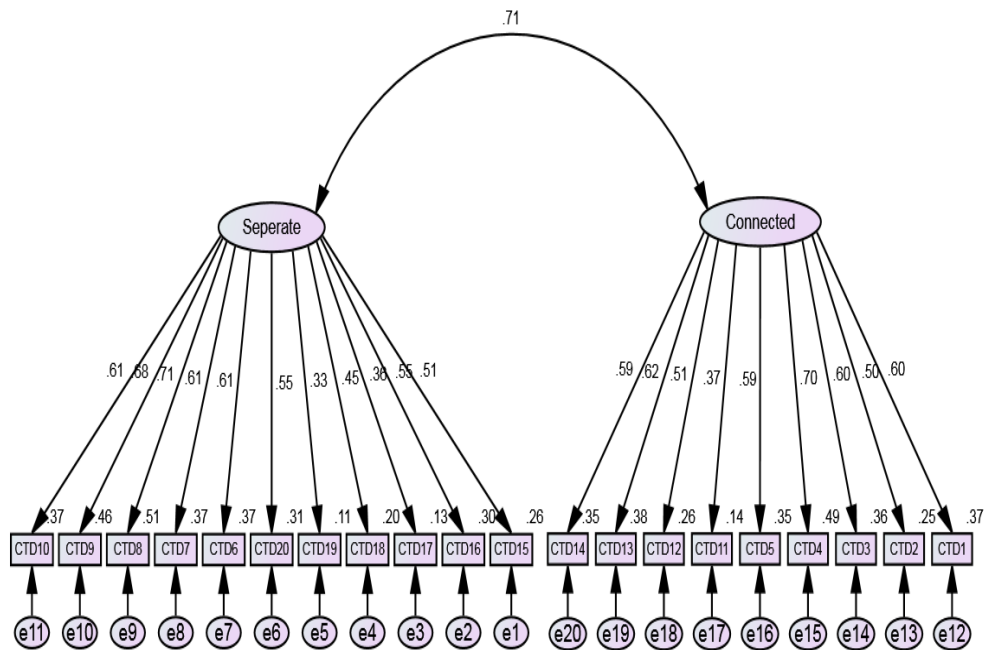


Figure 1. Confirmatory factor models for the two-factor model (model 1)



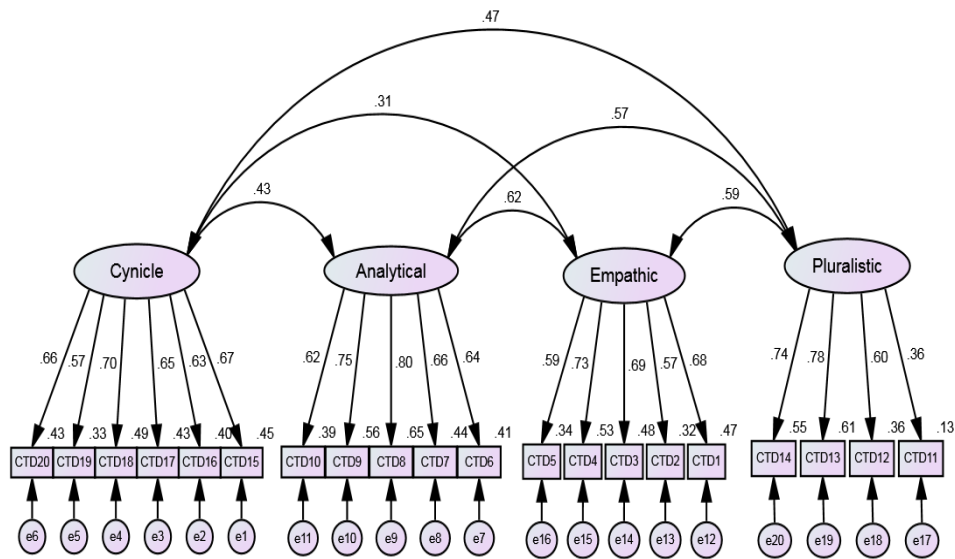


Figure 2. Confirmatory factor models for the four-factor model (model 2)

### Discussion

The purpose of this study was to contribute to the body of knowledge on the assessment of CTDS by further evaluating the construct validity. This study provides the empirical evidences to confirm a factor structure of previous study which used exploratory techniques by replicating the descriptive statistics and using a confirmatory method.

The current descriptive statistics and results of the reliability of the CTDS were very similar to the previous results (Poondej et al., 2013). Moreover, Alpha values of both studies were consistent and ranged between .70 and .82, which is acceptable (Hatcher, 2013; Nunnally, 1978). The results suggest that the current study reconfirmed the stability and reliability of the CTD instrument.

The results of the construct validity by confirmatory factor analysis techniques demonstrated the acceptance of the use of four-factor model of the CTDS. Compared to the two-factor model, the goodness-of-fit values and the construct validity of the four-factor structure were more suitable. The result also was a replication of the evaluation of the factor structure of CTDS (see

Poondej et al., 2013). Therefore, these findings confirmed the robust four-factor structure of the CTDS.

Until now there is no agreement on certain critical thinking disposition, the assessment depends on the concepts selected. This study again confirmed the validity of the critical thinking disposition instrument that used the ways of knowing concept (Belenky et al., 1997). The four components (cynical, analytical, empathic, and pluralistic) of critical thinking disposition have been proposed. These components are the major focus of educational psychology. Empathic and pluralistic thinking disposition involve transformation learning theory introduced by Jack Mezirow (1991). There is a close relationship between the ideals of empathic and pluralistic and the conditions of reflective discourse. In the context of transformation learning theory, reflective discourse is the main key of transformational learning (Mezirow, 2000). It is a critical assessment of assumptions imbedded in the social discourse. This reflection could lead to new understanding by assessing each other's reasons, arguments, and alternative perspectives, and then building consensus. In addition, to enhance meaningful understanding of learning process, cynical and analytical thinking disposition are the main keys. Finally, these components provide the habits of mind to make individuals engage problems and make decisions by scrutinizing arguments, considering on multi-perspective of views, and logical reasoning.

### **Conclusions**

In conclusion, critical thinking is considered a goal of education that is important for teaching and learning process (Kuhn, 1999; Phan, 2011; Prévost, 2014). It is a high-level of reflective thinking (Phan, 2011) and a cognitive activity that requires disposition thinking to activate the process (Valenzuela et al., 2011). According to this study, we contributed the empirical evidence that supported four components (cynical thinking, analytical thinking, empathic thinking, and pluralistic thinking) as a measure of critical thinking disposition.

This study has a number of limitations. Firstly, although most fit indices of the four-factor model of CTDS indicated an acceptable model fit with the data, these values had not reached the level of good fit, which the value should be above .95 for CFI, GFI, and NFI and less than .05 for RMSEA. Secondly, in terms of diverse populations the sample in this study was drawn from the same

educational level as the previous study. The results associated with this study, nevertheless, provided an important expansion of evaluation of the CTDS by confirming the use of this instrument with undergraduate student in Thailand. Moreover, this study suggests implications for the study pertaining to measurement of critical thinking disposition.

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