Construct Validity Examination of Critical Thinking Dispositions for Undergraduate Students in University Putra Malaysia

Ibrahim Ghadi (Corresponding author)
Faculty of Educational Studies, University Putra Malaysia, Malaysia
E-mail: gs22066@mutiara.upm.edu.my

Nor Hayati Alwi
Faculty of Educational Studies, University Putra Malaysia, Malaysia
E-mail: nalwi@putra.upm.edu.my

Kamariah Abu Bakar
Faculty of Educational Studies, University Putra Malaysia, Malaysia
E-mail: kamarab@educ.upm.edu.my

Othman Talib
Faculty of Educational Studies, University Putra Malaysia, Malaysia
E-mail: ot@educ.upm.edu.my

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Abstract

This research aims to evaluate the psychology properties of the construct validity for the Critical Thinking Disposition (CTD) instrument. The CTD instrument consists of 39 Likert-type items measuring seven dispositions, namely analyticity, open-mind, truth-seeking, systematicity, self-confidence inquisitiveness and maturity. The study involves 433 undergraduate students in University Putra Malaysia. The findings showed that the CTD has satisfactory construct validity with seven factors extracted and confirmed by confirmatory factor analyses. Construct validity results are supported with the Cronbach's alpha values which indicates high validity and reliability for the instrument to measure critical thinking dispositions.

Keywords: Construct validity, Confirmatory factor analysis, Critical thinking dispositions

1. Introduction

In institutions of higher education, it is imperative for students to think critically as the content of education at this level requires higher order thinking such as the ability to apply critical evaluation, give evidence for their opinions, and argue the validity of facts they receive from teachers. However, it has been previously reported by (Norris, 1985) that critical thinking ability is not prevalent among students.

Fundamentally, a good thinker tends to possess certain qualities such as cognitive abilities, in addition to thinking strategies and skills. Essentially, what sets good critical thinkers apart is not simply the superior cognitive ability or particular skills they processes; it is rather their tendencies to explore, inquire, seek clarity coupled with their abilities to take intellectual risks, think critically and imaginatively.

In their argument, (Tishman et al., 1992) referred to these tendencies as "thinking dispositions". It has been strongly claimed by (Numrich, 2006) and (Brookfield, 2006) that being a good critical thinker, especially with respect to the importance of dispositions means having the right thinking dispositions.

In general, critical thinking is termed as a cognitive process, a purposeful self-regulatory judgment that has two components or skills, namely cognitive skills and motivation. The former stresses on interpretation, analysis, inference, evaluation, explanation and self-regulation, while the latter mainly refers to the disposition toward critical

thinking. Being a good thinker means having certain sorts of critical and creative thinking abilities. Good critical thinking is associated with procession of intelligent thinking skills. Additionally, it is important to have motivations, attitudes, values and habits of mind which play key roles in good thinking, and in a large part they are those elements that determine whether people use their thinking skills when it counts.

The aim of this study is to validate the instrument that measures students' critical thinking dispositions. Specifically, the study attempts to answer the following research objectives: (1) to construct or validate the measurement scale of students' critical thinking dispositions using CTD instrument, in particularly, (2) to analyze the second-order factor of the CTD instrument, and (3) to examine the reliability of the instrument using Cronbach`s Alpha coefficient.

2. Literature Review

The roles of motivational dispositions as an essential component of critical thinking have been stressed by researchers studying critical thinking skills (Facione et. al., 2000). Facione, (Sanchez & Facione, 1994) perceived thinking disposition as a constellation of attitudes, intellectual virtues, and habits of mind. Furthermore, Facione, (Facione & Giancarlo, 2000) have described the overall critical thinking dispositions as the consistent internal motivation to engage problems and make decisions by using critical thinking.

In an attempt to explain key aspects of critical thinking dispositions, (Facione et al.,1996) and (West et al. 2008) have proposed seven scales, namely: (1) the truth seeking scale targets, which is the disposition of being eager to seek the best knowledge in a given context, being courageous about asking questions, and having honesty and objective about pursuing inquiry even if the findings do not support one's self-interests or one's preconceived opinion; (2) the open-minded scale addresses being tolerant of divergent views and sensitive to the possibility of one's own bias; (3) the analyticity scale targets prizing the application of reasoning and the use of evidence to resolve problems, anticipating potential conceptual or practical difficulties, and consistently being alert to the need to intervene; (4) the systematicity scale measures being organized, orderly, focused and diligent in inquiry; (5) the inquisitiveness scale on the CCTDI measures one's intellectual curiosity and one's desire for learning even when the application of the knowledge is not readily apparent; (6) the self-confidence scale measures the trust one places in one's own reasoning processes; and (7) the maturity scale targets the disposition to be judicious in one's decision-making.

Previously, (Facione *et al.*, 1995) explored CTD among fresh college undergraduate students in a private university. Among the 587 first year students, only 13% exhibited positivism on all the seven CTD scales of the California Critical Thinking Disposition Inventory. The remaining 87% responded negatively to at least one of the seven aspects of the overall disposition toward critical thinking.

It has been recently reported by (Stanovich, 2010) and (Nickerson, 2008) that in considering the implications of CTD findings for instruction and developmental academic advising, it would be wise to remember that a disposition is not merely a skill; hence, it remains to be determined whether a stronger tendency towards cognitive maturity predicts greater skill at making mature judgments. According to the findings, a stronger inclination towards analyticity may or may not predict greater analytical skills. It appears that strength in a given dispositional attribute indicates that a person is more inclined to use what skills he or she may have, while opposition to a given aspect of the overall disposition towards critical thinking suggests that a person would be inclined not to use his or her skills, even if they were considerable.

3. Research Method

3.1 Participants & Sampling

The participants of this study involve 433 undergraduate students from University Putra Malaysia (UPM). Participants were chosen using purposive sampling with status of study (Year 1, Year 4). The participants were chosen in percentage according to the year of study in which 193 students are selected from Year 1 and 240 students from Year 4 in UPM.

3.2 Instrument

The CTD measures the "willingness" for a student to think critically. In another words, its conceptual dimension involves the expression of readiness/ eagerness/ enthusiasm and ability to think critically. The instrument composed of seven critical thinking subscales, namely, description: analyticity, open mindedness, truth seeking, systematicity, self-confidence, inquisitiveness and maturity. The questions regarding each subscale are randomly interspersed, and the names of the scales are not identified on the assessment.

The CTD instrument is divided into two parts: demographic information (i.e. gender, academic major and year of study). The second part includes forty seven items of critical thinking sub skills drawn by a variety of sources

(Manrique, 2011); (Descartes, 2010); (Stanovich, 2007); (Bochario, 2004); (Robert, 2003) and (Pintrich et *al.,* 1993), which are rated with a six-point likert rating scale (i.e. 1.Strongly Disagree; 2.Moderately Disagree; 3.Slightly Disagree; 4.Slightly Agree; 5.Moderately Agree; 6. Strongly agree).

3.3 Content Validity

In this study, a questionnaire has been validated by a panel of judges who are lecturers in the field of curriculum and instruction, and supervisory committee. All these experts are lecturers at University Putra Malaysia who validated the suitability of the research questionnaire and test to be used in the Malaysian context. This panel was selected based on their experiences in the field of education, their knowledge in research work as well as their familiarity with the subject.

CTD instrument survey disseminated to three critical thinking experts in the Faculty of Education, University Putra Malaysia for validation. The validators' response revealed that the CTD is a highly suitable instrument. The researcher made relevant improvements based on comments from the validators.

3.4 Construct Validity

Construct validity requires a definition with clearly specified conceptual boundaries (Newman, 2002) and concerned with the underlying attributes rather than with the scores the instrument produces (Salkind, 2000). The validation emphasizes a logical analysis and tests the relationships predicated based on theoretical considerations.

3.4.1 Convergent Validity

Convergent validity is a method to test construct validity. The word of construct shows a theoretical viewpoint to explain some phenomenon (Wiersma, 2000). According to (Van Dalen, 1973) states that construct usually refers to a complex concept which includes several interrelated factors. In this study, convergent validity was assessed by factor loading, Composite Reliability (CR) and Average Variance Extracted (AVE) (Fornell & Larcker, 1981) .

Confirmatory Factor Analysis (CFA) is conducted to estimate factor loading of variables. In fact, a factor loading presents the level of a regression path from a latent to its indicators. In this study, all of latent variables had at least three indicators (the questionnaire item). According to (Hair et al.,2010), an acceptable factor loading value is more than 0.5 and when it is equal to 0.7 and above it is considered good for one indicator.

The level of CR is another guideline to review convergent validity. Although Cronbach's alpha is a very popular coefficient to test reliability (Bollen & Long, 1993) and (Garson, 2011). According to (Hair et al., 2010), the acceptable value of CR is 0.7 and above. It is calculated by Equation 1.

$$CR = \frac{(\sum_{i=1}^{n} \lambda_{yi})^2}{(\sum_{i=1}^{n} \lambda_{yi})^2 + (\sum_{i=1}^{\rho} Var(\varepsilon_i))} \quad (1)$$

CR = Indicates composite reliability

λ_y= The standardized factor loading

$Var(\varepsilon_i)$= The variance due to the measurement error.

The third method to check construct validity is applying AVE. It measures the level of variance captured by a construct versus the level due to measurement error and its values more than 0.7 is considered very good, whereas, the level of 0.5 and above is acceptable (Hair *et al.,* 2010). It is calculated by Equation 2.

$$AVE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n} \quad (2)$$

AVE =Average variance extract

λ_i = The standardized factor loading

n = The number of items

3.4.2 Discriminant Validity

Discriminant validity is a test to ensure there is no significant variance among different variables that could have the same reason. Discriminant validity indicates to differentiate between one construct and another in the same model. To assess discriminate validity, two common ways are used by researches. According to (Hiar et al. 2010), if the correlations of two latent variables exceed 0.9, they have significant overlapping constructs. In another words, multicollinearity exists among them. The second method to assess discriminate validity is comparing AVE and the

squared correlation between two constructs. (Fomell & Larcker 1981) state that to check the discriminate validity, the level of square root of AVE should be greater than the correlations involving the constructs.

3.5 Data Analysis

The data were analysed using SPSS. Three statistical procedures were employed in analyzing the data in order to answer the questions of this study. The analyses procedures are:

1) Descriptive analyses used to obtain the distribution of respondents based on demographic variables of gender, institution and year of study.
2) Confirmatory factor analysis (CFA) using the AMOS data-fitting program was applied to further confirm the construct validity of items and constructs used in the main study.
3) Reliability analysis using Cronbach's alpha.

4. Results

The results of the CFA for the adapted CTD instrument as shown in Figure 1 show a good fit between the data (N=433) and the measurement model. The measurement model has Chi square= 186 P<.05. The ratio of the minimum discrepancy to its degree of freedom, CMIN/df was 2.8. The data revealed that the fit statistics for the revised measurement model is good compared to the hypothesized measurement model. All of the fit indicators (Table 1), the GFI = .818, CFI = .957 and TLI = .952 fulfill the threshold of .90, the standard deemed important for model fit. However, the root mean square of approximation (RMSEA = .064) indicated a good fit of the hypothesized model. As a result of good fit based on the goodness-of-fit indices, this model has to be revised.

Insert Table 1 about here.

Measurement model of CTD represents the seven influential. These latent variables indicated by three to ten observed variables. Seven CTD factors latent variables and their indicators with standardized factor loading of them are presented in Figure 1. These seven latent constructs are Analyticity, Open mind, Truth seeking, Systematic, Self confidence, Inquisitiveness and Maturity.

Insert Figure 1 about here.

Table 2 shows the standardized factor loading of all items on their constructs are more than the acceptable level (> 0.5) after removing low factors loading indicator. To test of convergent validity moreover factor loading, AVE and CR should be checked. All components have the acceptable level of AVE between a range of 0.665 to 0.915 (Analyticity=0.803, Open mind=0.665, Truth seeking=0.871, Systematic=0.797, Self confidence=0.837, Inquisitiveness= 0.915 Maturity= 0.861). Similarly, all the components have a good level of composite reliability (more than 0.7); Analyticity=0.973, Open mind=0.888, Truth seeking=0.976, Systematic=0.921, Self confidence=0.973, Inquisitiveness=0.985, Maturity= 0.961.Hence, three conditions for convergent validity based on factor loading, AVE, and CR were met. Finally all of Cronbach's alphas were more than 0.7 in the acceptable level.

Insert Table 2 about here.

The second approach to test of discriminant validity is comparing AVE of each variable with the square construct correlation between any two constructs. In this way AVE should be greater than the square construct correlations. Table 3 illustrated comparing the AVE of five components of the square construct correlations. The diagonal elements of the table show AVE of any two constructs are greater than the square correlation between them.

Insert Table 3 about here.

The results of testing convergent validity and discriminant validity revealed a good construct validity and reliability except the discremenant between truth seeking- open mind, inquisitiveness- open mind, maturity- open mind and Maturity- Inquisitiveness.

5. Conclusions and Implications

In conclusion, the adapted CTD underwent the process of confirmatory factor analysis to validate the items and constructs related with the items. Results of the revised instrument showed suitable construct validity. The items in seven subscales were valid in assessing students' critical thinking dispositions. Results of reliability analysis also showed that this instrument has a good reliability.

Implication can be emphasized from this study is that methodological approach where it showed the usefulness of CFA in validating the items (Analyticity, Open mind, Truth seeking, Systematic, Self confidence, Inquisitiveness, Maturity) and constructs consisted in the adapted CTD. We can therefore conclude that the instrument was suitable and can be used in the context of higher education in Malaysia. Future research can examine the actual processes

going on during the learning activities by using qualitative method in analyzing the items. This is due to the importance of the critical thinking dispositions students use in their study which has a significant impact on both the quality of the learning and their academic success.

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Table 1. Goodness-of-fit indices of the CTD measurement model

Fit Index	**Recommended Value** (Hair *et al.*, 2010)	**CTD Model**
x^2/df	≤ 3	186
RMSEA	≤ 0.08	.064
GFI	≥0.9	.818
RMR	<0.5	.056
NFI	≥0.9	.935
CFI	≥0.9	.957
TLI	≥0.9	.952
PNFI	The higher ,the better	.841

Table 2. Cronbach's Alpha, Factor loading and Convergent Validity

Cronbach` s Alpha	Construct	Items	Factor loading	AVE	CR
.974	Analyticity	Q1	.82	.803	.973
		Q2	.90		
		Q3	.88		
		Q4	.92		
		Q5	.90		
		Q6	.92		
		Q7	.89		
		Q8	.92		
		Q9	.91		
	Open mind	Q4	.82	.665	.888
		Q6	.78		
		Q8	.84		
		Q9	.82		
	Truth seeking	Q1	.92	.871	.976
		Q2	.92		
		Q5	.92		
		Q6	.94		
		Q8	.95		
		Q9	.95		

	Systematic	Q1	.79	.797	.921
		Q2	.92		
		Q3	.96		
	Self confidence	Q3	.86	.837	.973
		Q4	.92		
		Q5	.94		
		Q6	.95		
		Q7	.95		
		Q9	.92		
		Q10	.86		
	Inquisitiveness	Q4	.94	.915	.985
		Q5	.94		
		Q7	.95		
		Q8	.96		
		Q9	.98		
		Q10	.97		
	Maturity	Q1	.95	.861	.961
		Q2	.87		
		Q4	.94		
		Q5	.95		

Table 3. Discriminant Validity

	Analyticity	Open mind	Truth seek	Systematicity	Self confid.	Inquisitiveness	Maturity
Analyticity	.803*						
Open mind	.760	.665*					
Truth seeking	.707	.781	.871*				
Systematic	..338	.319	.243	.797*			
Self confidence	.509	.550	.490	.703	.837*		
Inquisitiveness	..669	.695	.801	.252	.534	.915*	
Maturity	.651	.688	.746	.225	.478	.912	.861*

Notes:*Diagonal elements report the AVE and other matrix entries report the squared correlation estimation between them.

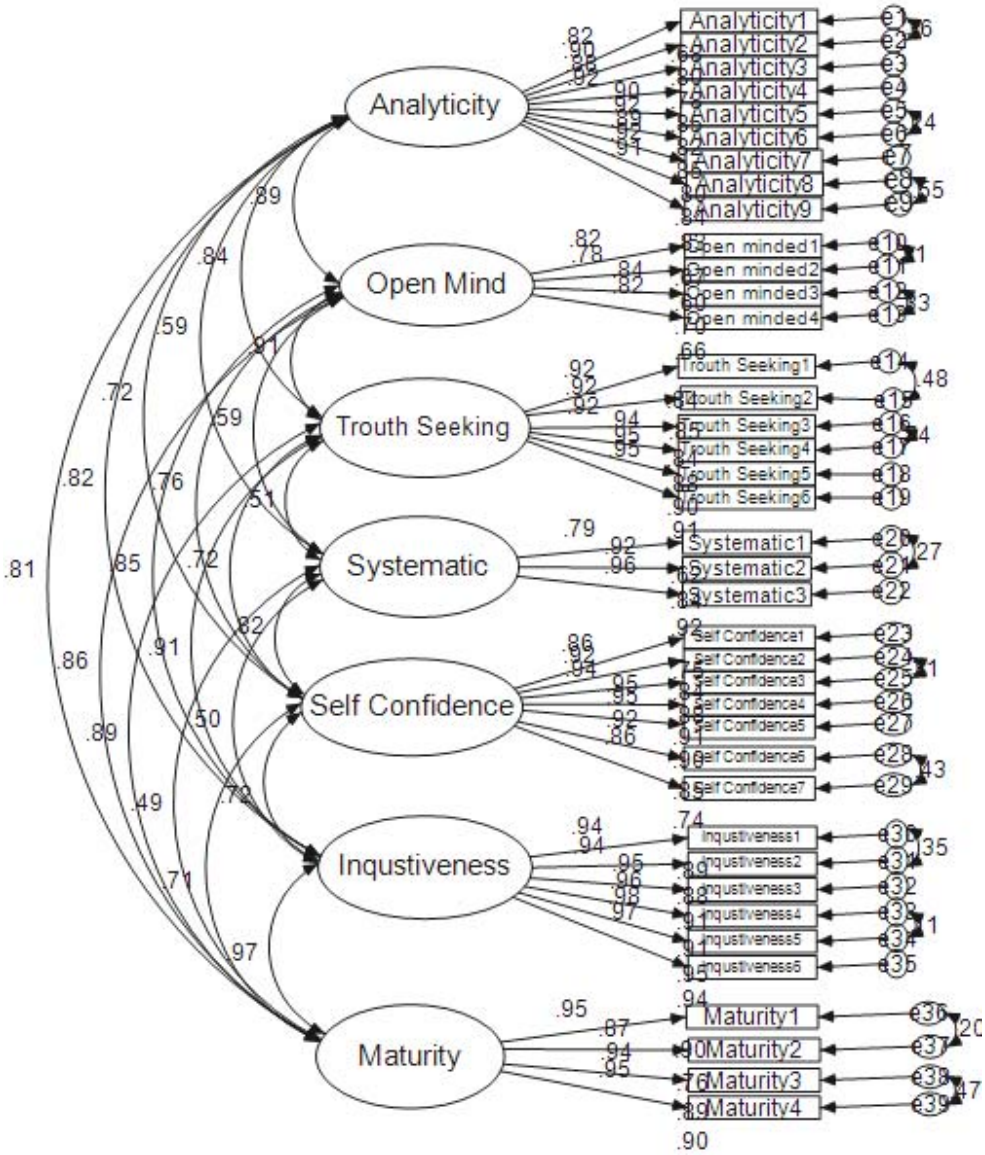

Figure 1. Critical Thinking Disposition Model