

Confirmatory Factor Analysis of the Conception for Teaching and Learning Questionnaire (CTLQ)

Timothy Teo

National Institute of Education, Nanyang Technological University
timothy.teo@nie.edu.sg

Chai Ching Sing

National Institute of Education, Nanyang Technological University
chingsing.chai@nie.edu.sg

The two-factor (traditional conception, constructivist conception) of the Conception about Teaching and Learning Questionnaire (CTLQ) was examined through confirmatory factor analysis with a sample of 877 pre-service teachers from the National Institute of Education in Singapore. Analysis of the results indicated that the two-factor structure of the CTLQ was not supported. A principal axis factor analysis revealed a five-factor solution. By testing two alternative (4-factor and 5-factor) models for model fitness, the 5-factor was found to have the best fit. This study concludes with suggestions for further study with more diverse samples and cultures.

Keywords: Conception about Teaching and Learning Questionnaire; validation; confirmatory factor analysis, pre-service teachers

Teachers' beliefs or conceptions about teaching and learning have received attention from education researchers for the past decades. Bruner (1996) remarked that educational reforms that failed to address issues pertaining to teachers' beliefs are susceptible to many difficulties. Still, in recent years, studies on teachers' beliefs about teaching and learning have gained momentum (e.g. Ertmer, 2005; Hoy, Davis, & Pape, 2006; Jimoyiannis & Komis, 2007; Teo, Chai, Hung, & Lee, 2008). Studies of this nature inform teacher educators of the issues relating to the design and the evaluation of teacher education and professional development programs.

Studies about teachers' conceptions on teaching and learning have been conducted using either the traditional/transmissive and the progressive/constructive concept of teaching and learning (Entwistle, Skinner, Entwistle & Orr, 2000; Kane, Sanddretto, & Heath, 2002; Minor, Onwuegbuzie, Witcher, & James, 2002; Samuelowicz & Bian, 2001). The traditional/transmissive conception emphasizes teaching as an act of transmitting knowledge from authoritative sources such as the teachers or the textbooks to the students who assume the role of passive recipients. The progressive/constructive views of teaching on the other hand challenges the traditional view and

postulate that teaching is an act of facilitating students' active sense-making processes (Lim & Chai, in press). In reality, teachers' views are likely to be eclectic and highly contextual in nature. More importantly, the relationship between beliefs and practice is complex and difficult to explain (e.g. Fang, 1996; Lim & Chai, in press; Segal, 1998). A contributing source to such difficulty lies in the measurement of the conception about teaching and learning. In this paper, we aim to contribute to the literature on teachers' beliefs by examining the Conception about Teaching and Learning Questionnaire (CTLQ) (Chan, 2001).

The Conception for Teaching and Learning Questionnaire (CTLQ) is a two-factor, 30-item questionnaire designed to measure the *Traditional Conception* and *Constructivist Conception* of teaching and learning. Developed by Chan (2001), the CTLQ uses a 5-point Likert-type format ranging from 1 (strongly disagree) to 5 (strongly agree). The CTLQ yields a total score that ranges from 30 to 150, with a separate score calculated for each subscale: an 18-item traditional conception (TT) and a 12-item constructivist conception (CT). A high score for each item represents a positive response. Table 1 lists the items in the CTLQ.

The original sample comprised of two groups of trainee teachers in Hong Kong, predominantly of Chinese ethnicity ($n=385$), female (68.3%), and mainly between the age of 20 to 40. In the original paper by Chan (2001), the mean and standard deviation of the total score were not reported. The means for each factor ranged from 2.58 to 2.72 ($SD = .45$ to $.46$) for traditional conception factor and 1.81 to 1.94 ($SD = .02$ to $.03$) for constructivist conception factor. The two factors were generated using factor analysis with maximum Likelihood and oblimin rotation with the original sample of 385 students (teacher trainees at a university). Together, these two factors accounted for 28.92% of the variance in the scores with factor loadings of .30 and higher. The Cronbach alpha for the traditional conception and constructivist conception are both .84. The correlation between the two factors was not computed.

In recent years, the general movement of educational reforms around the world appears to have been moving toward constructivist-oriented pedagogy, and since teachers are key agents in many reform efforts, their views and beliefs about proposed pedagogy have direct bearing on the implementation of such reforms (Leung, 2008). In addition, beliefs are likely to be culture-specific and most studies on teachers' beliefs have been conducted in the West, thus more research in the Asian context is desirable (Chan, 2007).

Since its development, the CTLQ has been employed in various studies to examine the conceptions of teaching and learning among pre-service teachers in several Asian countries (e.g. Chan, 2004; Chan & Elliot, 2004; Chan, Tan & Khoo, 2007). However, since the cumulative variance that accounted for the factor scores was low (28.92%) in the original study and those in the other studies (see Chan et al., 2007 for a recent example), more data are needed. In addition, the originally-proposed two-factor of the CTLQ needs to be confirmed with an independent sample to augment its validity. The current study examined the factor structure of the CTLQ by using confirmatory factor analysis using AMOS 7.0.

METHOD

Participants were pre-service teachers attending the Postgraduate Diploma in Education (PGDE) at the National Institute of Education (NIE). They were invited to participate in this study through an announcement to complete an online survey questionnaire. Those who agreed were given a URL to login to. Of the 1,244 enrolled students, 877 (70.5%) students from both the primary and secondary programmes completed the survey. This sample size was sufficient to meet the recommended participant-to-item ratio of 10:1 for multivariate data analysis (Hair, Black, Babin, Anderson, & Tatham, 2006). In this study, the participant-to-item ratio was about 29:1. The age of the participants ranged from 21 to 45 years, with a mean of 26.0 years ($SD = 4.13$). There were 563 females (64.2%). Among

the participants, 340 (38.8%) were enrolled in the primary programme and 537 (61.2%) in the secondary programme.

RESULT

Descriptive statistics

The descriptive statistics of the measurement items are shown in Table 1. The mean scores range from 1.87 to 4.37. Majority of the items for the TT are below the mid-point of 3.00 (83.3%). On

the contrary, 100% of the items in the CT factor are above 3.00. This indicates that participants exhibited a stronger response for the CT factor relative of the TT factor. All standard deviations are below 1.00, indicating a narrow spread of item scores around the mean. Additionally, the data were examined for univariate normality. No items showed a skew or kurtosis value greater than the cutoffs of |3| or |8| recommend by Kline (2005), respectively, and this supports univariate normality in the items.

Table 1

Descriptive Statistics of the items in the CTLQ

S/N	Item	Mean	SD	Skewness	Kurtosis
	Constructivist Conception ($\alpha = .88$)				
1.	The ideas of students are important and should be carefully considered.	4.08	.58	-.70	3.17
2.	Effective teaching encourages more discussion and hands-on activities for students.	4.05	.67	-.86	2.24
3.	Students should be given many opportunities to express their ideas.	4.15	.64	-.99	3.68
4.	In good classroom there is a democratic and free atmosphere which stimulates students to think and interact.	4.05	.70	-.91	2.16
5.	Every child is unique or special and deserves an education tailored to his or her particular needs.	4.08	.73	-.92	2.13
6.	Good teachers always encourage students to think for answers themselves.	4.15	.71	-1.10	3.11
7.	The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication.	3.88	.72	-.69	1.28
8.	Different objectives and expectations in learning should be applied to different students.	4.04	.64	-.94	3.26
9.	Good teachers always make their students feel important.	4.13	.71	-.91	2.22
10.	Instruction should be flexible enough to accommodate individual differences among students.	4.01	.69	-.88	2.06
11.	It is important that a teacher understands the feelings of the students.	4.37	.63	-1.36	5.42
12.	Learning means students have ample opportunities to explore, discuss and express their ideas.	4.34	.64	-1.31	5.02
	Traditional Conception ($\alpha = .84$)				
13.	The major role of a teacher is to transmit knowledge to students.	3.35	.89	-.54	-.53
14.	Learning occurs primarily through drill and practice.	2.90	.89	-.10	-.77
15.	During the lesson, it is important to keep the students confined to the textbook and the desks.	1.87	.73	.93	1.81

table continues..

Table 1 continued

16.	Teachers should have control over what students do all the time.	2.67	.90	.33	-.32
17.	Teaching is simply telling, presenting or explaining the subject matter.	2.09	.76	.95	1.79
18.	Students have really learned something when they can remember it later.	3.43	.96	-.49	-.45
19.	Good teaching occurs when there is mostly teacher talk in the classroom.	1.96	.68	.61	1.36
20.	Students have to be called on all the time to keep them under control.	2.65	.83	.16	-.47
21.	Learning means remembering what the teacher has taught.	2.83	.91	.12	-.64
22.	A teacher's major task is to give students knowledge/information, assign them drill and practice, and test their recall.	2.65	.90	.14	-.65
23.	Learning mainly involves absorbing as much information as possible.	2.61	.85	.29	-.50
24.	Good students keep quite and follow teacher's instruction in class.	2.65	.88	.12	-.41
25.	The traditional/lecture method for teaching is best because it covers more information/knowledge.	2.61	.76	.06	-.16
26.	It is best if teachers exercise as much authority as possible in the classroom.	2.93	.82	-.03	-.12
27.	Teaching is to provide students with accurate and complete knowledge rather than encourage them to discover it.	2.24	.75	.80	1.12
28.	A teachers task is to correct learning misconception of students right away instead of verify them for themselves.	2.76	.81	.23	-.48
29.	Learning to teach simply means practicing the ideas from lecturers without questioning them.	1.95	.68	.90	2.44
30.	No learning can take place unless students are controlled.	3.07	.97	-.09	-.66

The internal consistency (Cronbach alpha) for TT and CT are .84 and .88 respectively. This is above the acceptable level of .70 recommended by Hair et al., (2006). To uncover the factor structure of the CTLQ, a PCA was performed using Varimax rotation with Kaiser Normalization. The scree method, which is based on the magnitude of increments between eigenvalue of components extracted, was used to select the components underlying the CTLQ. Table 3 shows the factor loadings for principal components analysis with Varimax rotation for scores obtained in the CTLQ. This table also shows a comparison between this study and a Hong Kong sample for item loadings, eigenvalues, and variance explained: A two-factor

solution with eigenvalues of 6.27 and 4.96 for factors 1 and 2 respectively. The two-factor solution accounted for 37.4% of total variance explained. This low value of the total variance explained suggested that a large part of the variance was not explained by the two-factor structure of the CTLQ. The correlation between TT and CT was calculated to be -.28, statistically significant at $p < .01$. This supports the construct validity of TT and CT as they represent opposite conceptions of teaching and learning.

To further assess the two-factor structure proposed by Chan (2001), a confirmatory factor analysis (CFA) was conducted with AMOS 7.0 using maximum likelihood procedure as the

technique for parameter estimation. The maximum likelihood procedure is among the most popular and robust methods for use in structural equation modeling (Hoyle, 1995). The SEM technique employs fit indices to provide estimates of how well the data fit the *a priori* hypothesised model. Because different indices reflect different aspects of model fit, multiple indices are typically reported. In addition to the chi-square statistic, the other fit indices selected for this study are: (a) the Goodness of Fit Index (GFI); (b) the Comparative Fit Index (CFI); (c) the Incremental Fit Index (IFI); and (d) the root mean square error of approximation (RMSEA).

The GFI is a measure of the relative amount of observed variance and covariance accounted for by the model and is analogous to R^2 in multiple regression analysis (Hoyle & Panter, 1995; Kline,

2005). The CFI compares how much better the model fits compared to a baseline model, typically the independence (null) model in which the observed variables are assumed to be uncorrelated (Jöreskog, 1993; Kline, 2005). The IFI is similar to the CFI in that it compares how much better the model fits compared to a baseline model; however, the IFI takes into account the complexity of the model by rewarding more parsimonious models with higher values (Mueller & Hancock, 2004). The RMSEA takes into account the error of approximation in the population and is a measure of discrepancy per degree of freedom (Byrne, 2001; Jöreskog, 1993). Adequate model fit is represented by GFI, CFI, and IFI values greater than .90 (Hoyle and Panter, 1995) and RMSEA values below .05 (Byrne, 2001).

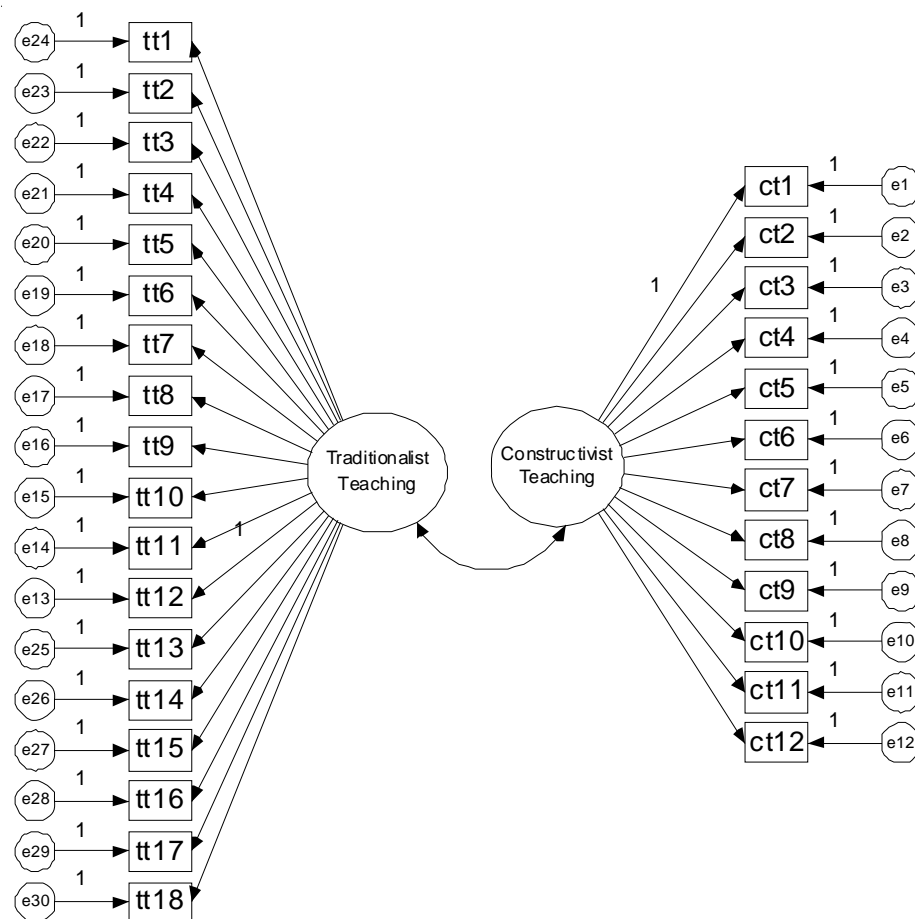


Figure 1. Path diagram of the two-factor model for the Conception about Teaching and Learning Questionnaire

Table 2
Test of Propose and Alternative Models

Model	χ^2	χ^2/df	GFI	CFI	IFI	RMSEA
A (2-factor)	1891.04	4.681	.844	.814	.815	.065
B (4-factor)	1382.17	3.464	.897	.877	.878	.053
C (5-factor)	1122.87	2.843	.916	.909	.909	.046

Fig. 1 shows the path diagram for the 2-factor model for the CTLQ. As seen in table 2, there was not a good fit. An examination of the modification indices in the AMOS software revealed excessive covariances among the residuals of the observed variables. Because the first-order CFA results did not adequately explain the causes of the misfit, an exploratory analysis was conducted in an attempt to uncover the structure underlying the item responses. Specifically, a principal axis factor analysis was used to assess dimensionality. It is important to note that this method was not used by the developer of the CTLQ to assess the structure in the original development (Chan, 2001), where the principal components analysis was used. The current study employed the principal factor axis because it considers the measurement error of the observed variables in the analysis (Benson & Nasser, 1998). An examination of factor loadings in the model suggests that there might be more than two factors in the questionnaire. Using the eigenvalue more than once and the scree plot as a guide for factor extraction, it appeared that the items for CT loaded on one factor and those for TT loaded on four factors. Based on the findings from the PAF analysis, two alternative models were proposed for model testing: 4-factor model (1 factor for CT, 3 factors for TT) and 5-factor model (1 factor for CT, 4 factors for TT). The results are shown in Table 2.

CONCLUSION

This study is a confirmatory factor analysis of the Conception about Teaching and Learning

Questionnaire (CTLQ) using a sample (n=877) of pre-service teachers, similar to the one reported in the original study (Chan, 2001). The results of this study do not support a two-factor solution. While the item constructive conception loaded into one factor, those of the traditional conception loaded on four factors.

There are four items in factor 1, four items in factor 2, eight items in factor 3, and two items in factor 4 of the traditional conception. When the CTLQ was re-specified as a 5-factor model, a good fit was found, as shown in Table 2. Suggested labels for each of the five factors are shown in Appendix 1. These are: Constructivist Teaching (12 items), Teacher-centred Teaching (7 items), Directive Teaching (5 items), Transmissive Teaching (4 items), and Rote Teaching (2 items).

The limitations of this study should be noted when applying the findings. First, the sample in this study comprised mainly female students (similar to the sample in the original study). Second, the medium of instruction of the course that the sample in this study was studying was English whereas the sample in Chan's (2001) study comprised of students from the English and Chinese streams. This is noteworthy given that there were significance t-test differences in both the traditional and constructivist conceptions of teaching and learning between the English and Chinese course students in the original sample (Chan, 2001).

This study advances the literature given the data provided on the CTLQ with a sample of pre-service teachers from a different country with an educational system that caters to a population consisting of diverse ethnic groups. Nevertheless,

further studies should include participants who vary in gender, age, and racial or ethnic backgrounds to examine the factorial and structural validity of the CTLQ. Moreover, given that the original questionnaire has 30 items loading on two proposed dimensions, future research may examine the validity of the original traditional teaching dimension in terms of reducing the number of items or validating the four dimensions that have emerged from this study.

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APPENDIX 1**Item loadings for the 5-factor scale**

	Item	CT	TC-T	DT	T-T	RT
1	The ideas of students are important and should be carefully considered.	.549	-.299	.002	-.036	.007
2	Effective teaching encourages more discussion and hands-on activities for students.	.476	-.304	.007	-.157	.193
3	Students should be given many opportunities to express their ideas.	.639	-.247	-.061	-.058	.123
4	In good classroom there is a democratic and free atmosphere which stimulates students to think and interact.	.615	-.212	-.077	.006	.127
5	Every child is unique or special and deserves an education tailored to his or her particular needs.	.676	-.090	-.007	-.031	.033
6	Good teachers always encourage students to think for answers themselves.	.720	-.118	.045	-.114	.054
7	The focus of teaching is to help students construct knowledge from their learning experience instead of knowledge communication.	.538	-.062	.118	-.305	.021
8	Different objectives and expectations in learning should be applied to different students.	.638	-.185	.070	.010	-.061
9	Good teachers always make their students feel important.	.667	-.068	-.083	.133	.016
10	Instruction should be flexible enough to accommodate individual differences among students.	.651	.074	-.138	.066	-.043
11	It is important that a teacher understands the feelings of the students.	.764	-.092	-.051	.094	-.089
12	Learning means students have ample opportunities to explore, discuss and express their ideas.	.774	-.152	-.103	.052	.002
13	During the lesson, it is important to keep the students confined to the textbook and the desks.	-.344	.579	.207	.240	-.030
14	Teaching is simply telling, presenting or explaining the subject matter.	-.160	.689	.051	.086	.110
15	Good teaching occurs when there is mostly teacher talk in the classroom.	-.359	.558	.149	.170	.014
16	The traditional/lecture method for teaching is best because it covers more information/knowledge.	-.096	.459	.344	.254	-.017
17	Teaching is to provide students with accurate and complete knowledge rather than encourage them to discover it.	-.193	.672	.105	.122	-.070
18	A teachers task is to correct learning misconception of students right away instead of verify them for themselves.	-.034	.459	.244	.052	.156
19	Learning to teach simply means practicing the ideas from lecturers without questioning them.	-.294	.597	.035	.074	.140
20	Teachers should have control over what students do all the time.	-.103	.137	.530	.298	.034
21	Students have to be called on all the time to keep them under control.	-.072	.255	.472	.236	.069
22	Good students keep quite and follow teacher's instruction in class.	-.012	.364	.391	.091	.246

23	It is best if teachers exercise as much authority as possible in the classroom.	.001	.117	.790	.064	.016
24	No learning can take place unless students are controlled.	.005	.065	.751	.040	.068
25	The major role of a teacher is to transmit knowledge to students.	.136	.111	.026	.701	.059
26	Learning occurs primarily through drill and practice.	-.033	.115	.311	.688	.088
27	A teacher's major task is to give students knowledge/information, assign them drill and practice, and test their recall.	-.058	.270	.231	.662	.220
28	Learning mainly involves absorbing as much information as possible.	-.051	.234	.219	.486	.346
29	Students have really learned something when they can remember it later.	.142	-.022	.104	.125	.745
30	Learning means remembering what the teacher has taught.	.016	.235	.064	.223	.763

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