

# Structural equation model of college foreign language writing and classroom teaching quality from perspective of teacher evaluation

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## Abstract

Existing teaching quality evaluation systems have insufficient comprehensive indices reflecting teaching quality: index repetition, complication, quantification difficulty, and difficulty in judging the relationship. To make classroom teaching quality evaluation consistent with teaching effect, element weight is confirmed based on a structural equation model. The present paper takes a college foreign language writing class as the object of study and sets up a structural equation model for classroom teaching quality evaluation. Effect coefficients of each variable are calculated, and the weight of each element of classroom teaching quality evaluation is then obtained. Such method avoids artificially scoring elements during the confirmation of element weight, reduces evaluation subjectivity, and makes the evaluation results more accurate, rational, and credible.

*Keywords:* structural equation model, teacher evaluation, classroom teaching, teaching quality

## 1 Introduction

The structural equation model originated from the path analysis concept introduced by Swell Wright in the 1920s. Structural equation model is also called simultaneous equation model and causal model etc. A great breakthrough in the development process of the structural equation model is the development of the concept of latent variable. It is the result of the joint development of latent variable and economics, etc. [4]. The structural equation model in this paper uses the latent variable. Traditional multivariate analysis method can only test the relationship between single independent variable and independent variable at the same time. Factor analysis can reflect the relationship among variables, but cannot further analyze causal relationships among variables. Although path analysis can analyze causal relationships among variables, complying with the following fundamental assumptions is difficult: zero fundamental assumption, unrelated residual error, and single-way causal relationship. A composite model which can synthesize these models is urgently needed. Structural equation model integrates path analysis, confirmatory factor analysis, and general statistical test method, and can analyze mutual causal relationship among variables. It contains advantages of factor analysis and path analysis. Meanwhile, it makes up for disadvantages of factor analysis, considers the error factor, and is not limited to assumed conditions of path analysis.

At present, the enrollment scale of Chinese higher education expands continuously. Problems caused by sharp expansion of enrollment scale include scarcity of teaching resources and reduction of teaching quality.

College classroom teaching quality thus becomes a social problem. No stable student pool under the condition where talent cultivation quality receives increasing attention without efficient classroom teaching quality. Thus, colleges will lose core competitiveness. Teaching quality is a multi-layer concept and a vital problem in the development of colleges. Since teaching quality involves the input, process, and results of teaching activities, as well as diversified public, teaching quality is a multi-dimensional evaluation index. Teaching quality refers to students' growth in knowledge, ability, and values, and is the result of comprehensive function of the whole teaching system. Scientific and effective classroom teaching quality evaluation is significant in achieving total teaching quality management and quality monitoring, and plays an irreplaceable role in improving teaching quality. On the other hand, in recent years, English writing ability of college students have received great attention. Unsatisfied employers noted that only 5% of college students have good writing and expression ability, whereas 37% of college students fail to reach the standards and are even poor in terms of writing ability. Thus, many colleges pay more and more attention to foreign language study and with a focus on writing training and cultivation. Many schools now strive to explore other methods and improve the evaluation of foreign language writing teaching results. During course teaching quality evaluation, students are the evaluation subjects, as they know whether the teaching method is effective. However, college course teaching is academically dependent, and final evaluation of teaching quality by students cannot really reflect actual situations.

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On the contrary, if students grasp the evaluation of course quality based on interaction between students and teachers this will have direct negative impacts on constructing harmonious student-teacher relationships. Thus, other subjects must be chosen. Teachers participate in evaluation index design, which reflects colleges respect for teachers' autonomous right. In this way, teachers can be aware of teaching evaluation significance and evaluation scheme bases, mentally accept evaluation indices, and provide professional evaluation from an objective perspective. Therefore, teacher evaluation is significant in classroom quality evaluation.

The features of structural equation model are as follows: many research variables cannot be directly be observed and measured like teaching quality. The concept of latent variable is applied when we need to study such variables, and corresponding dominant variables for a research are selected. For example, when we study classroom teaching quality, teaching quality is, to a great extent, reflected in final scores, which can be measured. Thus, structural equation model with latent variables is applied to classroom teaching quality. Structural equation model with latent variables have two basic modes: structure pattern and measurement pattern. Computational formula system approach is used to verify college foreign language writing teaching. Latent variable factors and their mutual causal relations can be explored through measuring and forming the system. The present paper sets up the structural equation model for college classroom teaching quality evaluation, expands research perspectives and research methods for college teaching quality on the basis of teacher evaluation, and establishes proper teaching quality evaluation indices to estimate teaching quality of foreign language writing class in a college.

## 2 Theory summary

### 2.1 STRUCTURAL PATTERN

Structural pattern states causal relationship between latent exogenous variables and latent endogenous variables. The structural equation is expressed as:

$$\eta = B\eta + \Gamma\zeta + \zeta \quad (1)$$

where  $\zeta$  is the latent exogenous variable (latent independent variable) matrix,  $\eta$  is the latent endogenous variable (latent dependent variable) matrix.  $\Gamma$  is the structure coefficient matrix that represents the effects of  $\zeta$  on  $\eta$  in the structural model.  $B$  is structure coefficient matrix that represents the mutual effects of component factors of  $\eta$  in the structural model, and  $\zeta$  is the residual error matrix of the structural equation.

### 2.2 MEASUREMENT PATTERN

Measurement pattern explains the relationship between latent variables  $\eta$  and  $\zeta$ , and measured variables  $y$  and  $x$ .

The measurement equation in terms of  $X$  is  $X = AX\zeta + \delta$ , where  $X$  is the measured variable matrix of  $\zeta$ ,  $AX$  is the

measurement coefficient matrix that represents the relationship between  $\eta$  and measured variable  $X$  and  $\delta$  is residual error matrix of the measurement equation.

The measurement equation in terms of  $Y$  is  $Y = AY\eta + \varepsilon$ , where  $Y$  is the measured variable matrix of  $\eta$ ;  $AY$  is measurement coefficient matrix that represents the relationship between  $\eta$  and measured variable  $Y$ , and  $\varepsilon$  is the residual error matrix of the measurement equation.

## 3 Construction of structural equation model of college foreign language writing classroom teaching quality from perspective of teacher evaluation

### 3.1 THEORETICAL MODEL FOR TEACHING QUALITY

The structural equation model does not offer the general pattern to set up the theoretical model. Theoretical model construction is based on the research each relevant field and the study of index system establishment. The present paper starts from the perspective of teacher evaluation. Given that teachers tend to be more professional and objective when evaluating course quality, 4 latent variables and 16 observed variables are set (Table 1) The structural model is composed of 3 exogenous latent variables (teaching attitude, teaching content and teaching method) and 1 endogenous latent variable (teaching effect).

Teaching attitude. Teaching attitude involves strictly following teaching discipline, putting sufficient time and energy to prepare lessons and improving teaching methods after class, actively shortening distance with students, communicating with students freely and creating harmonious student-teacher relationship. Teaching attitude reflects the teachers' degree of valuing classroom teaching. Teachers' teaching attitude can directly impact teaching quality as the first key index. Teaching attitude is reflected through 4 indices, i.e. I11, U12, U13 and U14 (Table 1).

Teaching content. Teaching content is the core of classroom teaching, the basic link of knowledge hierarchy construction by students, and the core of classroom teaching quality evaluation. Only when teaching content is correctly planned can the accuracy of classroom teaching quality evaluation be guaranteed. Teaching content refers to the knowledge imparted to students by teachers in the knowledge hierarchy. For most colleges, course teaching content has no absolute uniform requirement. Each college can order teaching materials as needed, and teachers can expand the scope of knowledge on the basis of the teaching material. Evaluation should include indices U21, U22, U23, and U24 (Table 1).

Teaching method. Teaching method refers to the method and process used by teachers to impart knowledge to students. Teaching methods mainly include tools and methods, which directly affect the improvement of teaching quality. Teaching method mainly consists of indices U31, U32, U33, and U34 (Table 1).

TABLE 1 Latent variables and observed variables in the structure

Type of latent variable	Latent variable	Type of observed variable	Observed variable
	Teaching attitude		U11: carefully and responsibly prepare lessons; teaching documents are complete U12: serve as a model for students; impart knowledge and educate students U13: carefully teach; strong enthusiasm for teaching U14: pursue studies rigorously; give strict requirements
Exogenous latent variable ( $\zeta$ )	Teaching content	Exogenous observed variable	U21: familiar with teaching materials and teaching plans; proficient in teaching U22: concepts are correct; highlight key points and difficult points; demonstration is precise and expression is correct U23: link theory and practice; reflect cutting-edge knowledge of the subject U24: teaching progress is moderate; class period is allocated rationally
	Teaching method		U31: vivid and concise language; logical; accurate examples U32: flexible and diversified teaching methods; pay attention to ability and quality cultivation U33: properly apply various modern teaching supplementary means U34: rational blackboard-writing layout; clear and tidy writing
Endogenous latent variable ( $\eta$ )	Teaching effect	Endogenous observed variable	U41: teaching is attractive; lively classroom atmosphere U42: point out reference materials, arrange after-class review; good classroom discipline U43: students have strong learning interest U44: students' mastery of basic knowledge, theory and skills

Teaching effect. Teaching effect directly reflects classroom teaching quality and classroom teaching quality evaluation indices. It means the approval of course necessity. Teaching effect is mainly reflected by indices U41, U42, U43, and U44 (Table 1).

### 3.2 DETAILED MODEL OF FOREIGN LANGUAGE WRITING CLASS

#### 3.2.1 Identification of structural equation

For foreign language writing class in particular, exogenous latent variables in Table 1 also contain "teacher quality." Teacher quality is mainly reflected in two aspects: "teachers' pronunciation is standard" and "teachers have strong listening, speaking, and comprehension skills." These are two corresponding exogenous observed variables. Aside from this, endogenous latent variable (i.e. teaching effect) can be divided into "students' ability to listen to and comprehend a foreign language" and "students' ability to speak and express a foreign language." Thus, the parameters ( $t$ ) that need to be estimated include 22 path coefficients  $\lambda(x)$  and  $\lambda(y)$  from latent variables to dominant variables. A total of 18 residual errors  $\delta$  and  $\varepsilon$  of dominant variables, 8 path coefficients  $\lambda(\zeta)$  and  $\lambda(\eta)$  among latent variables, 14 exogenous dominant variables ( $p$ ), and 4 endogenous dominant variables ( $q$ ) exist. The freedom degree of the path diagram of the model can be expressed as:

$$df = [(p + q)(p + q + 1) / 2] - t = 149 > 0.$$

Thus, the model can be identified.

#### 3.2.2 Fitting of structural equation model

The present paper utilizes AMOS software, selects CMIN/DF, RMSEA, GFI, AGFI and NFI) as evaluation indices, and calculates the fitting degree [8]. Table 2 shows the calculation results.

TABLE 2 List of fitting coefficients

Index	CMIN/DF	RMSEA	GFI	AGFI	NFI
Data	2.702	0.077	0.836	0.891	0.854

Bain et al., considering  $CMIN/DF < 3$ , show that the overall effect of the model is good. Lyle et al. note that if  $RMSEA < 0.08$  and the value of GFI, AGFI and NFI is between 0.8 and 0.9, then the mode exhibits a good fit. According to Table 2, the explanatory ability of structural equation model for foreign language writing teaching quality evaluation is strong.

#### 3.2.3 Parameter estimation and test

This paper adopts maximum likelihood method and applies AMOS software to analyze factor loading and path coefficient of each dominant variable, then normalization processing is carried out. Finally, normalized factor loading and normalized path coefficient are obtained.

In accordance with the principle of maximum likelihood method, when factor loading exceeds 0.4, the mode has a good explanatory ability. The normalized factor loading of the above dominant variables exceeds 0.4, which indicates that each factor has strong explanatory ability for measurement model. For the first exogenous latent variable teaching attitude  $\zeta_1$ , the loading of the observed variable  $X_1$  "U11" is the largest. This shows the first exogenous latent variable has the greatest contribution, followed by  $X_2$ ,  $X_3$  and  $X_4$ . Similarly, dominant variable  $X_6$  "U22",  $X_{10}$  "U32",  $X_{14}$  "teachers have strong ability in listening, speaking and comprehension",  $Y_1$  "U41", and  $Y_3$  "U43" have the greatest contribution to the exogenous latent variables "teaching content", "teaching method", "teaching quality", "students' ability to listen to and comprehend a foreign language", and "students' ability to speak and express a foreign language", respectively.

TABLE 3 Normalized factor loading

Dominant variable	Normalized factor loading	Dominant variable	Normalized factor loading
$X_1(\xi_1)$	0.6023	$X_{12}(\xi_3)$	0.4936
$X_2(\xi_1)$	0.4877	$X_{13}(\xi_4)$	0.5824
$X_3(\xi_1)$	0.4721	$X_{14}(\xi_4)$	0.6305
$X_4(\xi_1)$	0.5862	$Y_1(\eta_1)$	0.7082
$X_5(\xi_2)$	0.6417	$Y_2(\eta_1)$	0.5399
$X_6(\xi_2)$	0.7135	$Y_3(\eta_1)$	0.4768
$X_7(\xi_2)$	0.6628	$Y_4(\eta_1)$	0.4693
$X_8(\xi_2)$	0.4176	$Y_1(\eta_2)$	0.6270
$X_9(\xi_3)$	0.5034	$Y_2(\eta_2)$	0.5345
$X_{10}(\xi_3)$	0.6209	$Y_3(\eta_2)$	0.6547
$X_{11}(\xi_3)$	0.5470	$Y_4(\eta_2)$	0.5384

TABLE 4 Normalized path coefficients

Latent variable path	Normalized path coefficient	Significance at 0.0001 level	Verification result of Hypothesis
$\xi_1 \dots \rightarrow \eta_1$	0.6288	Significant	Support $H_1$
$\xi_2 \dots \rightarrow \eta_1$	0.8406	Significant	Support $H_2$
$\xi_3 \dots \rightarrow \eta_1$	0.8073	Significant	Support $H_3$
$\xi_4 \dots \rightarrow \eta_1$	0.7592	Significant	Support $H_4$
$\xi_1 \dots \rightarrow \eta_2$	0.6317	Significant	Support $H_5$
$\xi_2 \dots \rightarrow \eta_2$	0.8129	Significant	Support $H_6$
$\xi_3 \dots \rightarrow \eta_2$	0.7965	Significant	Support $H_7$
$\xi_4 \dots \rightarrow \eta_2$	0.8248	Significant	Support $H_8$

According to path coefficients of latent variables in the table, overall effects of exogenous latent variables  $\xi_1$ ,  $\xi_2$ ,  $\xi_3$  and  $\xi_4$  on endogenous latent variable  $\eta_1$  are 0.688, 0.8406, 0.8073 and 0.7592, respectively, and their effects on endogenous latent variable  $\eta_2$  are 0.6317, 0.8129, 0.7965 and 0.8248, respectively. This implies that if teaching attitude, teaching content, teaching method and teacher quality improve one standard unit, students' ability to write and comprehend a foreign language will increase by 0.688, 0.8406, 0.8073, and 0.7592 standard units, respectively, and students' ability to speak and express a foreign language will increase by 0.6317, 0.8129, 0.7965, and 0.8248 standard units, respectively.

Table 3 and Table 4 show that teaching attitude, teaching content, teaching method, and teacher quality have significant effects on two indices of foreign language writing teaching quality: "students' ability to write and comprehend a foreign language" and "students' ability to speak and express a foreign language". Thus, they can estimate teaching quality. Observed variables

$X_1$  "U11",  $X_6$  "U22",  $X_{10}$  "U32",  $X_{14}$  "teachers have strong ability in listening, speaking and comprehension",  $Y_1$  "U41", and  $Y_3$  "U43" have the greatest contributions to each latent variable, with each contribution significantly different from the others.

Therefore, the structural equation model forms a reliable quantification measurement scale with certain reliability and validity, and provides a weight coefficient and good theoretical support for displaying foreign language writing teaching quality.

### 4 Conclusions

Based on the perspective of teacher evaluation, the present paper investigates foreign language writing teaching quality of a college and presents a structural equation model for classroom teaching quality through analyzing and testing sample data. The application of structural equation model strengthens the objectivity of the weight of each element of teaching quality evaluation, and overcomes the subjectivity of scoring by experts using existing point-factor method. Its application on classroom teaching enhances the comparability of teaching quality and keeps evaluation results consistent. The model addresses the difficulty in directly measuring teaching attitude, teaching content, teaching method, and teacher quality, which have direct positive effects on teaching, and promotes studies on the cause and effect influencing foreign language writing teaching. Nowadays, colleges should improve teaching content and approach to enhance education and encourage the continuous improvement of colleges.

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