An Empirical Analysis of Student Satisfaction in Practical Teaching——Research Based on Structural Equation Model

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Abstract. Since the middle of the last century, so far, practical teaching has been the focus of vocational education in our country[1]. This paper compares other practical teaching models at home and abroad, based on the two courses of "Real Estate Operation and Management" and "Curriculum Design" in the civil engineering major of our school, and discusses the satisfaction of the curriculum theory and practical teaching model. This paper mainly adopts the satisfaction model proposed by American scholars, combined with the data collected by the questionnaire survey, constructs the student satisfaction model of the practical teaching link, and obtains the linear path coefficient of the student's practical teaching satisfaction and the student's satisfaction index for the practical teaching link, so as to improve reform measures such as the assessment system, and improve the level of practical teaching, and ensure the effectiveness of practical ability training.

1.Introduction
The academic education of the civil engineering specialty aims to train high-level application-oriented professionals suitable for the field of civil engineering[2]. At the same time, practical teaching is the key link of training applied talents needed by enterprises in our school. The effect of practical teaching will directly affect the quality of the students. How to improve the quality of practical teaching is the key to the reform of practical teaching in our school currently.

The earlier research on practical teaching focused on the necessity and importance of carrying out practical teaching[3]. The researchers discussed the role of practical teaching in vocational colleges from the perspectives of economics, politics, and pedagogy respectively. Most of the research and investigations in the society now mainly focus on the model and system reform of practical teaching, and less attention is paid to the satisfaction of practical teaching. How to improve the satisfaction of students with practical teaching is also an urgent issue that needs attention in today's society.

Satisfaction of students in practical teaching is an important indicator for evaluating and measuring the reform of practical teaching model and system. As the basis for promoting the management of satisfaction in practical teaching, quantifying the satisfaction of practice is also an urgent need of higher education. At the same time, the improvement of the satisfaction of the practice link not only improves the reform measures such as the assessment system, but also improves the practical teaching level and guarantees the effect of training practical ability.

2.Model Principles and Methods
Structural Equation Modeling, abbreviated as SEM, is a statistical method for studying the causality of social and natural phenomena, and is a commonly used technique for modeling based on linear statistics. According to the different properties of this method, it can be called Covariance Structure Models (abbreviated as CSM) or Causal Modeling. In recent decades, because the structural equation modeling can be used to process some more complex multivariate data, this great applicability has led it to become the most rapidly developing branch of applied statistics.

The main variables included in the structural equation model are: (1) exogenous variables, whose characteristics are similar to the concept of "independent variable" in traditional research; (2) endogenous variables, whose characteristics are similar to the concept of "dependent variable" in traditional research; (3) manifest or unobserved variables, which are variables that can be directly observed. (4) Latent or unobserved variables, that is, variables that cannot be directly observed. The basic structure of the structural equation model is divided into "measurement model" and "structural model".

2.1 Measurement Model

The measurement model is the basis of the entire structural equation model, also known as the confirmatory factor analysis model, which mainly represents the relationship between the latent variable and the measurement index. The main basic purpose of the measurement model is to describe whether the observation variable is suitable as a measurement method of latent variable or factor, the expression is as follows:

\[ Y = \Lambda_y \eta + \varepsilon \]  
\[ X = \Lambda_x \xi + \delta \]

As shown in Figure, In the structural model, \( Y \) is the observation index of \( \eta \), \( X \) is the observation index of \( \xi \); \( \Lambda_y \) is the load matrix of \( Y \) against \( \eta \); \( \Lambda_x \) is the load matrix of \( X \) against \( \xi \); and \( \varepsilon \), \( \delta \) is the measurement error of \( Y \) and \( X \) respectively. The first equation represents the relationship between the endogenous observed variable \( Y \) and the endogenous latent variable (ie \( \eta \)). The second equation represents the relationship between the exogenous observed variable \( X \) and the exogenous latent variable (ie \( \xi \)). Assuming \( \varepsilon \) and \( \delta \) are independent, the measurement error (between \( \varepsilon \) or between \( \delta \)) or the two latent variables may be correlated. When there is no measurement error in \( Y \) or \( X \), the corresponding element in \( \varepsilon \) or \( \delta \) is zero.

2.2 Structural Model

After determining the latent variables in the measurement model, the mutual relationship between the latent variables can be evaluated in the structural model. Structural model is also called structural equation or latent variable model, the expression is as follows:

\[ \eta = B\eta + \Gamma \xi + \zeta \]

The structural model is established to reflect the effect relationship between latent variables. \( \eta \) represents the corresponding endogenous latent variable, \( \xi \) is the external latent variable. Endogenous and exogenous latent variables are connected by linear equations with coefficient matrices \( B \) and \( \Gamma \) and error vector \( \zeta \), where \( \Gamma \) represents the effect of exogenous latent variables on endogenous latent variables, and \( B \) represents the effect of some endogenous latent variables on other endogenous latent variables, and \( \zeta \) stands for regression residual. Assume \( E(\zeta) = 0 \), and \( \zeta \) is not related to \( \xi \) and \( \eta \).
3. Build the Model

3.1 Indicator Variable Definition
As for the influencing factors of satisfaction in practical teaching, the satisfaction model proposed by American scholar Fornell is mainly used. The satisfaction index model believes that factors that affect user satisfaction mainly include customer expectations, perceived quality, perceived value, brand impression, satisfaction, user complaints, and loyalty. As shown in Figure 1:

There are six structural variables in ACSI, and the target variable is customer satisfaction. The cause variables are customer expectations, perceived quality, and perceived value. The outcome variables are customer complaints and customer loyalty. Each variable contains multiple observation variables, which are obtained through experimental investigation.

![Figure 1: Satisfaction Degree Index Modelling in America](image)

For many students, the practical teaching is often a one-time perceived behavior, and it is less involved in secondary practice. Therefore, when constructing the satisfaction model of practical teaching, the factors as latent variables are customer expectations, perceived quality, perceived value, and user satisfaction. The model ignores issues such as brand impression and user loyalty. Among the four variables mentioned above, user satisfaction is an endogenous latent variable, and user expectations, perceived quality, and perceived value are exogenous latent variables. The satisfaction model of the practical teaching link constructed is shown in Figure 2:

![Figure 2: Student Satisfaction Model in Practical Teaching](image)

3.2 Data Collection
In this paper, through questionnaire survey, taking civil engineering undergraduates of Shenzhen Open University as a case study, we collected relevant data on the satisfaction of practical teaching. The questionnaire survey on the satisfaction of practical teaching is divided into three parts. The first part is mainly to understand the research objects, including gender, grade, occupation, basic knowledge of practical teaching, etc.; the second part is the subjective evaluation of self-realization, perceived quality, and perceived fairness in practical teaching. The three indicators are scored separately by students; the third part is the outline of the interview, which is divided into students and teachers. A total of 446 questionnaires were
distributed, with 435 valid questionnaires, with an effective rate of 98.5%. The basis for judging whether the questionnaire is valid or not: whether the student has omissions, multiple choices, or the entire questionnaire scored more than 80% is the same score, or the time to answer the questionnaire is less than 3 minutes. As shown in Table 1:

Table 1  Index System of Satisfaction Model for Practical Teaching

| Survey Question                                                                 | Problem Scoring |
|--------------------------------------------------------------------------------|-----------------|
| 1  meet your overall expectations                                               | 1   2  3  4  5 |
| 2  meet the expectations of your academic needs                                 |                 |
| 3  meet the expectations of your work needs                                     |                 |
| 4  meet the expectations of self-improvement                                    |                 |
| 5  satisfaction of overall quality level                                        |                 |
| 6  relevance to professional courses                                            |                 |
| 7  relevance to graduation project topics                                       |                 |
| 8  satisfaction with teacher guidance                                           |                 |
| 9  satisfaction with the evaluation mechanism of practical teaching            |                 |
| 10 satisfaction with the utilization of teaching practice base                  |                 |
| 11 relevance to career planning                                                 |                 |
| 12 relevance to the job                                                          |                 |
| 13 satisfaction with practical applicability                                    |                 |
| 14 relevance to professional examination                                       |                 |
| 15 whether the practical operation ability has been fully exercised            |                 |
| 16 whether the calculate ability is fully exercised                             |                 |
| 17 whether the drawing ability is fully exercised                               |                 |
| 18 whether the design ability has been fully exercised                          |                 |
| 19 your perception of the overall value gained from practical teaching and the degree of gain and loss |                 |
| 20 your overall commitment to practical teaching and the degree to which you gain or lose your overall value |                 |
| 21 your overall satisfaction with practical teaching                            |                 |
| 22 your satisfaction with your ideal expectations                               |                 |

3.3 Constructing SEM Model of Satisfaction in Practical Teaching

According to the establishment of the structural model and the measurement model, and the SEM model of the satisfaction of the practical teaching link, the initial model is constructed as follows Figure 3:
3.4 Model Effect

3.4.1 Reliability Analysis
Reliability reflects the credibility of the test results. Cronbach $\alpha$ reliability coefficient is currently the most commonly used reliability coefficient, which is applicable to the test data or questionnaire data of the project multiple scores. Its formula is as follows:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^{k} S_i^2}{S_x^2}\right)$$

In the formula, $k$ is the number of questions in the test, and $S_i$ is the variance of the score of the i-th question, and $S_x$ is the variance of the total score of the test. As shown in Table 2:

| Reliability Standard          |
|------------------------------|
| Reliability coefficient      |
| 0.90 or more                 |
| 0.80 — 0.90                  |
| 0.70 — 0.80                  |
| 0.60 — 0.70                  |
| 0.60 or less                 |

It is generally believed that the $\alpha$ reliability coefficient needs to be above 0.7 in order for the test results to have a relatively high reliability. Use SPSS 19.0 to perform reliability analysis on user expectations, perceived quality, perceived value, and user satisfaction. The analysis results are shown in Table 3.

| Classification | Cronbach $\alpha$ |
|----------------|------------------|
| User Expectations | 0.654 |
3.4.2 Validity Analysis

Validity refers to the correctness of the problem to be explained by the statistical indicators (survey results), that is, whether the statistical indicators can correctly reflect the attributes or quantitative characteristics of the statistical objects. Validity is divided into content validity and structural validity[4]. Content validity refers to whether the designed index can reflect the measured attributes. The content validity of this article is mainly based on the induction and statistics of previous scholars' literatures, and at the same time soliciting suggestions and opinions from relevant people, so the content validity basically meets the requirements. The structural validity test adopts the factor analysis method, and the factor load is used as the evaluation index of the construction validity of the questionnaire. Use SPSS22.0 to conduct correlation analysis and factor analysis on the satisfaction of practical teaching.

When performing factor analysis, the spherical test of "KMO" and "Bartlett" must be done first. The KMO statistic is used to compare the simple correlation coefficient matrix and the partial correlation coefficient index among variables[5]. The closer the KMO value is to 1, the more suitable for factor analysis, and the original hypothesis of the Bartlett sphericity test is that the correlation coefficient matrix is the identity matrix. If the Sig value rejects the null hypothesis, it indicates that there is a correlation between the variables, so it is suitable for factor analysis. The following table 4 shows the defined range of factor analysis of "KMO" value: As shown in Table 4:

| KMO Value | Explanation | KMO Value | Explanation |
|-----------|-------------|-----------|-------------|
| KMO>0.9   | very suitable | 0.6<KMO<0.8 | general |
| 0.8<KMO<0.9 | suitable | KMO<0.6 | not suitable |

The validity evaluation of this model is shown in Table 5.

Table 5  Results of Student Validity Test in Practical Teaching

| Variable            | KMO  | Bartlett Approximate chi-square | Sig  | Indicator Name | Factor Load |
|---------------------|------|---------------------------------|------|----------------|-------------|
| user expectations   | 0.731| 170.675                         | .000 | X1             | 0.771       |
|                     |      |                                 |      | X2             | 0.754       |
|                     |      |                                 |      | X3             | 0.719       |
|                     |      |                                 |      | X4             | 0.651       |
|                     |      |                                 |      | X5             | 0.645       |
|                     |      |                                 |      | X6             | 0.742       |
|                     |      |                                 |      | X7             | 0.654       |
|                     |      |                                 |      | X8             | 0.684       |
|                     |      |                                 |      | X9             | 0.785       |
|                     |      |                                 |      | X10            | 0.696       |

perceived quality    | 0.782| 455.196                         | .000 | X1             | 0.771       |
|                     |      |                                 |      | X2             | 0.754       |
|                     |      |                                 |      | X3             | 0.719       |
|                     |      |                                 |      | X4             | 0.651       |
|                     |      |                                 |      | X5             | 0.645       |
|                     |      |                                 |      | X6             | 0.742       |
|                     |      |                                 |      | X7             | 0.654       |
|                     |      |                                 |      | X8             | 0.684       |
|                     |      |                                 |      | X9             | 0.785       |
|                     |      |                                 |      | X10            | 0.696       |
It can be seen from Table 5 that the factor load interval of the measured variable is between 0.5 and 0.9, and the correlation coefficient is mostly above 0.7. It is generally accepted that the factor load is greater than 0.5 and the correlation coefficient is greater than 0.6. The correlation coefficient shown in the table is the degree of correlation between each measured variable and the overall variable score. The verification of the factor load and correlation coefficient of the questionnaire shows that the validity of the questionnaire is relatively high.

The reliability and validity of the indexes of user expectations, perceived quality, perceived value, and user satisfaction in the satisfaction of practical teaching are analyzed. On this basis, the software LISREL 8.70 is used again to perform regression analysis on the measurement model of user satisfaction in the elderly community, so as to calculate the contribution rate of user expectations, perceived quality, and perceived value to user satisfaction, and evaluate the importance of each variable.

### 3.5 Direct and Indirect Effects of the Model

After outputting the path diagram, attention should be paid to the indirect and direct effects of the model. The direct effect refers to the direct influence from the original variable to the result variable, and the path coefficient from the cause variable to the result variable is used to measure the size of the direct effect[4]. For example, the user expectations -> the perceived quality is a direct effect. The indirect effect refers to the indirect effect of the cause variable to the result variable by affecting one or more intermediary variables, but when there is only one intermediary variable, the size of the indirect effect is the product of two path coefficients. For example, the indirect effect of user expectations -> user satisfaction is perceived quality and perceived value. As shown in Table 6:

| Table 6 | Decomposition of Various Effects of Satisfaction in Practical Teaching |
|---------|---------------------------------------------------------------|
| **Independent Variable** | **Perceived Value** | **User Satisfaction** | **Perceived Value** | **User Satisfaction** |
| **User Expectations** | | | | |
| direct effect | 0.30 | -0.54 | direct effect | - | 0.48 |
| indirect effect | - | 1.45 | indirect effect | - | - |
| overall effect | 0.30 | 0.91 | overall effect | - | 0.48 |
| **Perceived Quality** | | | | |
| direct effect | 0.85 | 0.78 |
| indirect effect | - | 0.47 |
| overall effect | 0.85 | 1.25 |

It can be seen from Table 6 that the direct and indirect effects between the independent variables and endogenous variables between the structural equation models of the satisfaction degree of practical teaching, which facilitates the analysis of the different weights of the determinants of practical teaching satisfaction. Among the determinants of practical teaching satisfaction, perceived quality has the largest impact on satisfaction, with an impact effect of...
1.25; followed by user expectations, its impact effect on satisfaction is 0.91. Perceived value has the smallest effect on satisfaction. Therefore, it can be seen from the above-mentioned impact coefficients that the perceived quality is the most important factor, which has both direct and indirect effects on the satisfaction of practical teaching.

3.6 Path Coefficient Analysis of the Model

3.6.1 Positive Correlation Path Coefficient
According to the analysis structure of observation data, it can be seen that first, user satisfaction is strongly positively correlated with perceived quality, and the correlation coefficient is 0.85. This result reflects that students have had a general understanding of practical teaching through their classmates, friends and teachers before conducting practical teaching. Therefore, the expectations formed by practical teaching have roughly the same feelings after practice; secondly, user satisfaction is strongly related to perceived quality, and the correlation coefficient is 0.78, which means that quality can directly affect user satisfaction, so in order to improve the satisfaction of the practical teaching, only the quality and service of the practice link have to be fully improved. The correlation coefficient between perceived value and user satisfaction is not high at 0.48. This phenomenon fully shows that students are of quality preference when conducting practical teaching, which has a great correlation with students' perception of whether practical teaching is useful to themselves.

3.6.2 Negative Correlation Path Coefficient
In Table 6, there is only one path of negative correlation coefficient. The user expectations have a strong negative correlation with user satisfaction, and the correlation coefficient is -0.54. This also coincides with the status quo of the development of in-service education in our school. Because the educational background of in-service education students and the types of work are different, it shows that its development has not fully met the needs of students. In summary, the primary task of improving user satisfaction in practical teaching is to improve the perceived quality of practice.

4. Conclusion
Based on the satisfaction model proposed by American scholars, this paper discusses the functional relationship between user expectations, perceived quality, perceived value, and user satisfaction, and uses the satisfaction evaluation of practical teaching as an example, and uses questionnaire survey data to analyze in detail the related factors that affect the satisfaction of practical teaching, and the application of structural equation model in satisfaction evaluation is analyzed by examples. The paper is based on the sample of undergraduates majoring in civil engineering of Shenzhen Open University. A total of 446 questionnaires were investigated. At the same time, the reliability and validity of the questionnaires were analyzed to ensure the validity of the survey data. The conclusions drawn by using the structural equation model are:

First, the perceived quality and perceived value have a direct impact on the satisfaction of practical teaching. Perceived quality has an indirect effect on the satisfaction of practical teaching through the perceived value. It can be seen from the road map of practical teaching satisfaction that the impact of perceived quality on satisfaction is far greater than the perceived value, as it can be seen from the numerical values, this bias is relatively large. Therefore, it fully shows that students are quality-perceived perceivers. In order to improve the satisfaction of practical teaching as soon as possible, we should first pay attention to whether they meet the needs of students to improve their work, academic and self-ability.

Second, from the perspective of the relationship of the observed variables between user expectations and perceived quality, students have the highest expectations for job requirements, followed by academic needs and self-improvement needs[5]. This also reflects that the current practical teaching link should still put students' career planning and job positions in the first place, and then pay attention to the improvement of academic and self-ability.
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