Research on Factors Influencing Satisfaction with Practical Teaching of Information and Communication Technology Majors Based on Regression Models

Ke Zhao[1,a], Liyuan Cai[2,b], Yanan Miao[1,c*]

[1]Chengdu Technological University, Department of Network & Communication Engineering, Chengdu, China
[2]Chengdu Technological University, Department of Big Data and Artificial Intelligence, Chengdu, China

[a]38024084@qq.com
[b]8415708@qq.com
[c*]miaoyanan33@163.com

Abstract. Starting from the cultivation of information and communication technology talents in universities, the main influencing factors of the data are analyzed by proposing research hypotheses, conducting questionnaire surveys and collecting survey data to develop scales and adopt principal component analysis and Lasso regression in this paper. The correlation existing in the main factors is demonstrated by Pearson Correlation Analysis to verify the main factors influencing student satisfaction in professional practice teaching in the cultivation of information and communication technology talents. The results show that practical teaching objectives, practical teaching design, practical teaching implementation, and practical teaching feedback evaluation are the main factors affecting student satisfaction with practical teaching. This paper proposes some suggestions to improve the satisfaction of professional practice teaching based on the educational theory. Suggestions for improving the satisfaction of professional practical teaching are proposed from the aspects of closely integrating industry talent cultivation standards, taking students as the teaching center, strengthening student professional cognitive education, and establishing collaborative education mechanisms.

Keywords: Talent cultivation, Practical teaching, Student satisfaction, Lasso regression analysis.

1 Introduction

With the further development of a new round of scientific and technological revolution and industrial transformation in the world, the software and information technology service industries are facing with new development opportunities. The application-oriented universities should accelerate the cultivation of information and communication technology talents to response to the demand of the times. The theoretical application

M. Yu et al. (eds.), *Proceedings of the 2024 5th International Conference on Big Data and Informatization Education (ICBDIE 2024)*, Advances in Intelligent Systems Research 182,
https://doi.org/10.2991/978-94-6463-417-4_6

ability is strengthened and practical ability is improved through professional practice teaching to provide strong talent support for promoting the development of modern information technology industry. Therefore, it has become a key link to master the satisfaction of students with professional practical teaching to improve the effectiveness of practical teaching and the quality of information and communication technology talent cultivation. This paper establishes a Lasso regression model to quantitatively analyze and verify the influencing factors and results of student satisfaction in practical teaching of information and communication technology major from an empirical perspective. Finally, a reasonable path and method is explored to improve the quality of practical teaching, enhance student learning satisfaction and learning effect.

2 RESEARCH HYPOTHESES

In the past three years, the project team has continued to perform research on the student satisfaction in application-oriented universities. An empirical research was conducted on the satisfaction survey of university students in multiple domestic and foreign universities in the 21st century through preliminary sorting and verification, and a model of influencing factors on the satisfaction of application-oriented talent cultivation in universities was established finally[1]. The relevant research have been conducted by Dou[2], Liu[3], and other researchers on the origin and definition of satisfaction assessment for university students. The project team constructed a model of influencing factors on the satisfaction of application-oriented talents cultivation in universities by exploring the model of American Customer Satisfaction Index (ACSI) created by Fornell[4], and the model of influencing factors on the satisfaction of non-academic distance learning constructed by Liu[5]. On the basis, according to the characteristics of information and communication technology talent cultivation and the reality of education and teaching and combining with the evaluation index system of professional practice teaching quality, requirements of innovation and entrepreneurship education, career planning and employment guidance, this study designs the satisfaction test index and corresponding scale of information and communication technology professional practice teaching to reflect the students' subjective perception and preference of educational value and learning experience and ensure the reliability and validity of the questionnaire[6]. The prediction data were verified and analyzed, and the questionnaire was revised and improved through the pretest. Finally, a total of 52 statistical variable scales (h1~h52) were formed, including the implementation of practical teaching subjects, object cognitive satisfaction, the whole process of practical teaching, learning environment and atmosphere, and satisfaction with the work of counselors.

Then, the random sampling method was adopted based on the practical teaching of information and communication technology talent cultivation in application-oriented universities. The students of related majors were taken as the research object and the relative data were collected through questionnaire survey. A total of 480 questionnaires were distributed and 475 valid questionnaires were received. The effective rate of the questionnaire is 95.21 %. Five options representing different degrees are set. That is, A

is very satisfied, B is more satisfied, C is general, D is not very satisfied, E is not satisfied. In this way, the students' personal subjective willingness and evaluation can be tested to form the sample data of this study.

The corresponding hypotheses on the influence of professional practical teaching on student satisfaction is proposed combined with the practice of information and communication technology talent cultivation in application-oriented universities.

Firstly, the setting of practical teaching objectives is reflected in the student satisfaction with cognitive education in practical teaching (h9) which is the starting point of teaching process and is helpful for teachers to choose effective teaching strategies, and guide students to understand the objectives and significance of learning. Therefore, hypothesis 1 (H1) is proposed: the setting of practical teaching objectives has a positive and significant impact on student satisfaction.

Secondly, the practical teaching design is reflected in the student satisfaction with professional practical teaching curriculum (h10) which are the planned activities to achieve teaching objectives. According to the requirements of course and the characteristics of students, the teaching elements are arranged orderly and the teaching schemes are determined reasonably, which is helpful to improve the teaching efficiency and quality. Therefore, hypothesis 2 (H2) is proposed: the practical teaching design has a positive and significant impact on student satisfaction.

Thirdly, the implementation of practical teaching is reflected in the student satisfaction with the offered professional practical teaching courses (h14) which is the central stage for achieving teaching objectives, and the key link for transmitting teaching content, teaching knowledge and skills and stimulating learning motivation and interest. Therefore, hypothesis 3 (H3) is proposed: the practical teaching implementation has a positive and significant impact on student satisfaction.

Fourthly, the evaluation of practical teaching is reflected in the student satisfaction with the innovative awareness and ability cultivation of professional practical teaching (h15) which is a process of judging the value of practical teaching activities, so as to adjust teacher teaching behavior and stimulate student learning motivation. Therefore, hypothesis 4 (H4) is proposed: the practical teaching evaluation and feedback has a positive and significant impact on student satisfaction.

3 Empirical research and analysis

3.1 Correlation Detection

Further research needs to be based on the correlation between variables. Therefore, the correlation tests were performed on 52 variables (h1~h52) mentioned above to generate the Pearson correlation coefficient heat map. It is found that there is a correlation between variables, which can be further studied. Among them, the deeper the color (red), the higher the correlation. It can be seen from Figure 1.

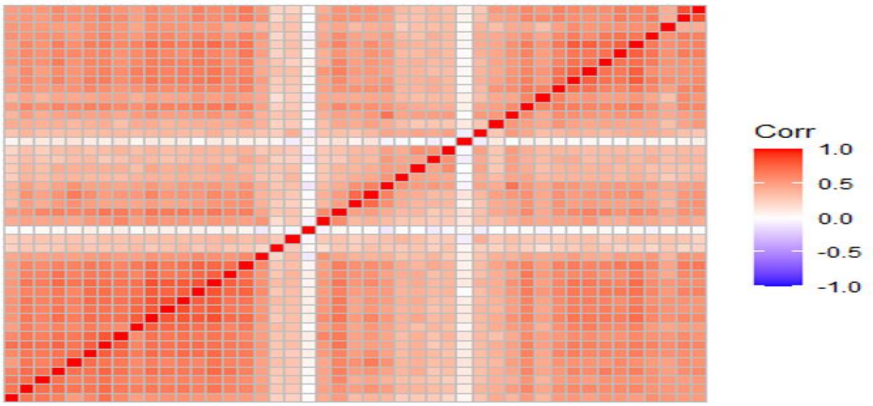

Fig. 1. Heat map of Pearson correlation coefficient for all variables.

3.2 Principal Component Analysis

Next, the main influencing factors on student satisfaction with professional practical teaching will be analyzed in this section. The software h11 and hardware h13 in the practical teaching process will be directly rated by students, and standardized as the dependent variable y , and the others are taken as independent variables. The results of correlation analysis are shown in Figure 2. The contribution rate of the first principal component is 50 %, and the others are small. There is at least 14 samples need to be selected to extract the principal components if the number of principal components is determined by the cumulative contribution rate of principal components exceeding 80 %. Obviously, the effect of extracting principal components is not perfect. Therefore, the principal component analysis model is not adopted in this paper.

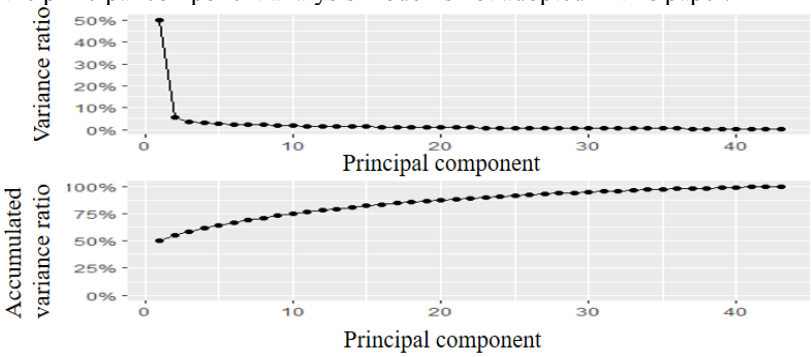

Fig. 2. Principal component analysis.

3.3 Lasso Regression Model

The other methods to analyze the main factors affecting the student satisfaction with professional practical teaching are adopted since the poor performance of principal

component analysis. Lasso regression is adopted considering that the possibility of the multicollinearity, autocorrelation and heteroscedasticity in the data. Similarly, the variable y is used as the dependent variable for origin linear regression. The Lasso regression formula can be obtained as follow.

$$\min \sum_{i-1}^{n} (y_i - \beta_0 - \beta_1 x_{i1} - \cdots - \beta_p x_{ip})^2 + \lambda \sum_{j=1}^{p} \left| \beta_j \right| \tag{1}$$

Where, x_{ip} is the $p-$th characteristic variable of $i-$th problem; y_i is the target variable of $i-$th problem; β is the regression coefficients for each characteristic variable; λ is a parameter of L_1 regularization term. The determination of λ in the whole model is the most critical, and the final effect of the whole model will be directly affected by the value of λ.

3.4 Determination of Regularization Term Parameters

Path of Coefficient Variation with Regularization Term.

Firstly, Python's lasso function is used to draw the path of coefficient variation with the regularization term. It can be seen from Figure 3. Figure 3 shows the regression coefficient (y axis) of each variable and the path of coefficient variation with the L_1 regularization term (x axis). The larger the L_1 regularization term $\sum_{j=1}^{p} |\beta_j|$ is, the smaller the λ is to minimize the formula (1) as a whole. In fact, with the gradual decrease of λ, more and more regression coefficients of characteristic variables are gradually zeroed (more and more characteristic variables enter the model). As shown in Figure 3, variables h10, h15h14, and h9 are introduced in the early stages of regularization term variations. The contained information is strongly correlated with the target variable and plays a crucial role in explaining the variations in the target variables.

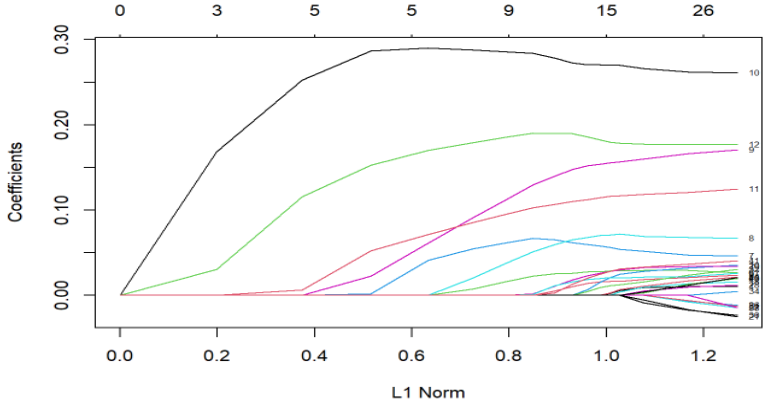

Fig. 3. Path of coefficient variation with regularization term.

Cross-Validation Estimation λ.

This paper adopts the cross-validation to estimate the adjustment parameter λ. Figure 4 shows a 10-fold cross-validation curve changing with $\log(\lambda)$. Each red dot represents the Mean- Squared Error (MSE) of a 10-fold cross-validation, and the length of its upper and lower error bars represents the standard deviation of 10 MSEs in each cross-validation. The figure helps us to understand the average level of model performance and the range of performance variations. The first of the two vertical dashed lines in the figure is the value that minimizes the cross-validation error. The second is to give the $\log(\lambda)$ value of the most regularized (λ as large as possible) model when the cross-validation error is kept within a standard deviation range of the minimum error. This paper adopts λ to minimize the cross-validation error. After calculation, the optimal value can be determined to be 0.030.

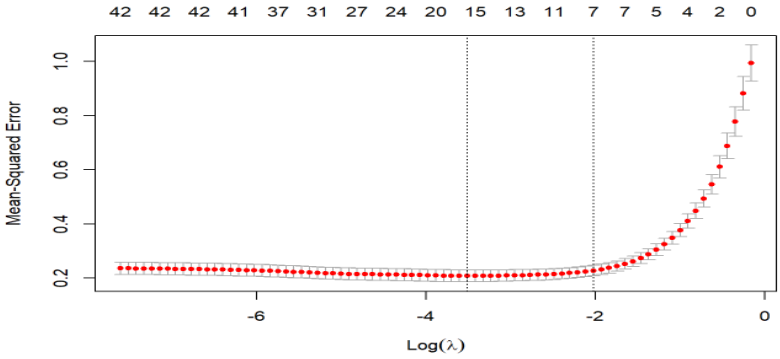

Fig. 4. Cross-validation estimation λ.

3.5 Lasso Regression Results

Each variable coefficient of Lasso regression can be obtained by using the optimal λ (0 if not specified). It can be seen from Table 1.

Table 1. Lasso regression results

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
h10	2.70E-01	h45	2.86E-02	H36	1.13E-02
h15	1.80E-01	h6	2.85E-02	H27	3.12E-03
h9	1.56E-01	h23	2.82E-02	H1	2.79E-03
h14	1.16E-01	h19	2.12E-02	H21	3.45E-04
h8	7.11E-02	h41	2.06E-02	h44	7.65E-06
h7	5.58E-02	h2	1.65E-02	(Intercept)	-2.23E-04

The R-squared prediction of Lasso regression is 0.815, which meets statistical requirements and confirms the regression conclusion. At the same time, the data are studied by Stepwise regression to prove the rigor of the research, and the same results can be obtained as well. The two regressions are also confirmed. Whether Lasso regression

or Stepwise regression, h9, h10, h14 and h15 are the four variables with the largest coefficients in the model.

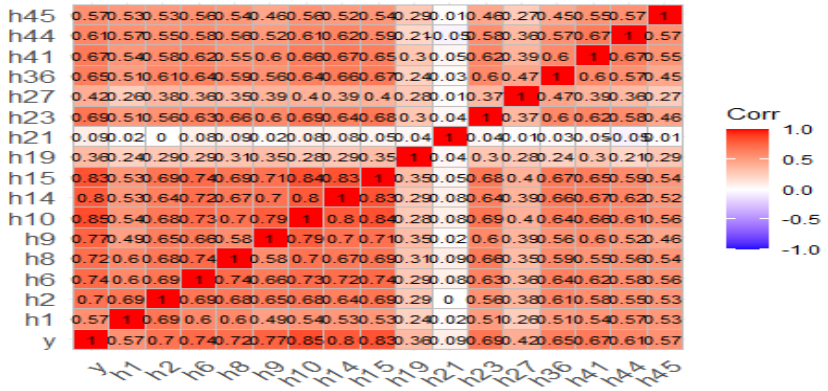

Fig. 5. Pearson correlation coefficient heat map of significant variables.

Through Lasso regression, 16 independent variables with a significant influence on y are determined (h1, h2, h6, h8, h9, h10, h14, h15, h19, h21, h23, h27, h36, h41, h44, h45), among which h9, h10, h14, and h15 have a particularly significant influence on y. The Pearson correlation coefficient heat map of significant variables is drawn in Figure 5, and 16 main statistical variables are finally obtained in Table 2.

Table 2. Description of statistical variables

Sign	Statistical Variables
h1	Satisfaction with the practical teaching environment
h2	Satisfaction with the practical teaching atmosphere
h6	Satisfaction with the school social reputation
h8	Willingness to recommend others to study this major
h9	Satisfaction with the cognitive education in practical teaching of this major
h10	Satisfaction with the practical teaching curriculum of this major
h14	Satisfaction with the offered professional practical teaching courses
h15	Satisfaction with the cultivation of innovative awareness and ability in professional practical teaching
h19	Willingness to transfer majors within the school
h21	Objective expectations for income in the first month after graduation
h23	Satisfaction with the work of counselors
h27	Satisfaction with hands-on practice in professional practice courses
h36	Satisfaction with the work of employment mentors
h41	Satisfaction with the use of MOOC system
h44	Satisfaction with learning resources and environment in library
h45	Satisfaction with the campus network environment

The above research results show that the assumed key variables are all in the optimal combination of predictors. The student satisfaction with the practical teaching of information and communication technology major in application-oriented universities has the most significant positive correlation with the practical teaching objectives, teaching design, teaching implementation and teaching feedback evaluation. There is also a significant positive correlation between the other variables, such as satisfaction with the practical teaching environment and the atmosphere, satisfaction with the school social reputation, and willingness to recommend to others to study this major. In addition, non-practical teaching directly related factors such as satisfaction with the work of counselors, satisfaction with the work of employment mentors, and satisfaction with the use of MOOC system also have a certain influence on the student satisfaction.

4 CONCLUSIONS

In this paper, 52 statistical variables are designed including the implementation of practical teaching subjects, object cognitive satisfaction, and the entire process of practical teaching based on the previous research. The principal component analysis and Lasso regression are carried out to analyze the main influencing factors through the investigation and collection of student satisfaction data of practical teaching of information and communication technology majors in universities. The four main factors affecting the student satisfaction in professional practical teaching are respectively practical teaching objectives, teaching design, teaching implementation, and teaching feedback evaluation to explore an effective way to improve the quality of professional practice teaching. According to the conclusion, it is recommended to improve the student satisfaction in the practical teaching of information and communication technology from the following aspects.

1. Integrating with the information and communication technology professional application-oriented talent cultivation standard system, setting professional practical teaching objectives and course content.
2. Combining with the physical and mental characteristics of students, implementing professional practical teaching on students, and focusing on cultivating their practical and hands-on abilities.
3. Strengthening cognitive education of major and industry, establishing evaluation and feedback mechanism, and improving the cooperative education mechanism of professional teachers, counselors and employment mentors.

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