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The CIPP-TOPSIS Comprehensive Evaluation Method for Computer Major Practice Teaching in Context of Intelligent Service Demand

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Abstract: Practice teaching evaluation is a systematic and comprehensive evaluation of students' performance in practical operations, experiments, internships and other practical activities, aiming to measure students' professional practice ability through reasonable evaluation, and is an important part of practice teaching in colleges and universities. Practical teaching evaluation needs to solve two problems, one is to determine the evaluation model for the evaluation system, and the other is to determine the weight of the evaluation system. Combined with CIPP comprehensive evaluation model, the evaluation system of computer professional practice teaching is built, and the weight of evaluation indicators for computer professional practice is determined by the combinatorial weighting TOPSIS method, so as to comprehensively measure and evaluate the effect of professional teaching practice from multiple perspectives.

Keywords: Engineering Education; Practical Teaching; Teaching Evaluation; Practical Ability

1. Introduction

The State Council's new generation artificial intelligence development plan centers around intelligence. The Ministry of Education's April 2018 Artificial Intelligence Innovation Action Plan for Colleges and Universities noted that professional construction should be enhanced and the "Excellent engineer education and training Plan" should be expedited [1]. In addition, it is vital to actively conduct new engineering research and practice in conjunction with students' learning interests and social needs because of the universality, mobility, and penetration of artificial intelligence theory and technology. It is also extremely important from a practical standpoint to investigate and study the intelligent innovative teaching and training model in the higher education stage.

The establishment of an experimental teaching demonstration center and the development of a practical teaching evaluation index system, which serves as the primary index for engineering education certification, has been one of the construction works generally valued by all colleges and universities [2-4]. It is crucial for advancing the development of laboratories, reforming practical education, and raising the standard of staff development. Consequently, for the practice teaching of computer science and technology, a scientific, thorough, quantitative, and qualitative assessment index system must be created [5-7].

2. Evaluation Index System of Computer Professional Practice Teaching based on CIPP Model

2.1 The CIPP Model for Educational Assessment

CIPP model is a typical evaluation model with great influence and is widely used in the construction of evaluation system. Four assessment sections come together to make the model: background, input, process, and result. Process evaluation and improvement are the main focus of these sections [8,9].

Based on the practical teaching process, four aspects are measured: first, background evaluation, that is, to clarify the industry demand and professional positioning of course implementation, and judge the demand for course opening and the degree of support after practical teaching; Second, the input evaluation is mainly the analysis and evaluation of the best evaluation of the teacher to achieve the teaching

goal, and the evaluation of the curriculum plan; Third, process evaluation, mainly through the evaluation practice process to find the specific teaching problems, so as to provide effective basis for teaching process revision; Fourth, the result evaluation, that is, according to the teaching arrangement to evaluate the actual teaching training results to get results.

2.2 Evaluation Process of Practical Teaching in Computer Science and Technology

The practical curriculum system of computer science and technology major in our university mainly involves software curriculum design, computer hardware curriculum design, software project training, professional comprehensive design, production practice, innovation and entrepreneurship comprehensive training, graduation design and other links. The continuity and support relationship between courses is shown in Figure. 1 [10]. The above practical teaching process mainly includes theoretical learning, experimental operation, project practice, practice training, evaluation and feedback. The general steps of the computer science practical teaching method are listed above; the specific teaching process may be modified based on the school's teaching plan and the students' individual learning circumstances.

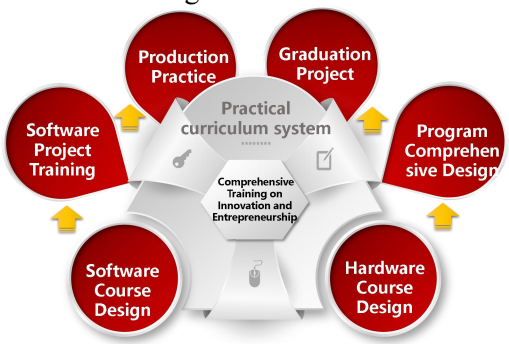

Figure 1. The Relation Diagram of Course Succession in Practical Curriculum System

In practical teaching evaluation, teachers need to evaluate students' practical teaching process, give feedback, help students understand their own advantages and disadvantages, guide students to improve their learning methods, and improve their learning effects [11,12]. The precise procedure is as follows:

2.2.1 Determine the evaluation index system oriented to professional practice

In order to evaluate students' software design ability effectively, A scientific and appropriate evaluation index method must be established. The following elements should be included in the evaluation index system:

(1) Software planning stage, including the development of software goals (this includes determining the scope of project implementation, developing a project implementation time plan, cost and budget plan, and human resource strategy, among other things.), demand analysis (through extensive study and analysis, the objective is to fully grasp the user and the project function, performance, dependability, and other particular needs).

(2) Software implementation phase, including software task decomposition (specifically refers to the software project is divided into multiple smaller, more manageable parts, is an important project management technology, can increase the transparency of the project, improve the controllability of the project schedule, And helps to allocate resources reasonably), schedule, resource allocation (involves planning, arranging and allocating the necessary human, material and financial resources and other resources to complete the task of the project, this process needs to be jointly responsible for the project designer, they need to use a variety of resource management tools and technologies), etc.

(3) Software execution phase, including software task execution (an important part of project management, which involves the implementation plan, resource coordination and risk management, etc.), team collaboration (mainly includes task management, communication, file sharing and progress tracking, etc.), communication management, etc.

(4) Software testing phase: It includes software supervision and control (in the process of project, coordinate the relationship between business requirements department and software developers, monitor the execution of software development tasks, and provide developers and management with information reflecting the software process), problem solving, and change management (in the process of software development, identify, evaluate, approve and control the process of change. To ensure the achievement of project objectives and the success of delivery).

(5) Software documentation stage, Including software requirements documents, design

documents (usually including system architecture, database design, user interface design and detailed design), test documents (usually including test plans, test cases and test reports), user manuals, project planning documents, configuration management documents, maintenance documents (usually including fault handling, performance optimization and system upgrade).

2.2.2 Collect student practice data

In order to conduct practice evaluation based on CIPP model, it is necessary to collect various data generated by students in the practice process [13-15]. This data can include aspects such as student personal information, practical task completion, teamwork, problem solving ability, etc. In addition, the quality and reliability of the data must be considered to ensure the correctness of the evaluation findings.

2.2.3 Choose an appropriate evaluation method

The practice evaluation method of software training needs to choose the appropriate evaluation method for data analysis and modeling. The commonly used evaluation methods include expert review method, questionnaire survey method, case analysis method, etc. When choosing the evaluation method, it is necessary to consider the feasibility and operability of the data and select the most suitable evaluation method for modeling and prediction. Based on multiple attribute decision analysis, this study chooses an assessment approach, the combination weighted TOPSIS method.

2.2.4 Establish the evaluation model

After selecting an appropriate evaluation method, an evaluation model needs to be built for data analysis and modeling. The evaluation model should include multiple parts such as input layer, hidden layer and output layer. Simultaneously, the complexity and interpretability of the model must be considered to ensure the model's correctness and dependability.

2.2.5 Validate and optimize the evaluation model

After establishing the evaluation model, the verification and optimization work of the model should be carried out. The validation process can be carried out through methods such as cross-validation to ensure the generalization ability and accuracy of the model. The optimization work can be carried out by adjusting the model parameters and increasing the training data to further improve the prediction accuracy of the model.

2.3 Based on CIPP Model and Service Intelligent Needs of Computer Practice Teaching Evaluation System

The practical assessment system for teaching of computer major based on CIPP model can help teaching to evaluate the effect of practical teaching comprehensively and systematically. At the same time, considering the transformation of intelligent needs in the new era of computer science and technology, the employment practice goal is integrated into the practical teaching evaluation system. The specific index system is constructed as follows:

2.3.1 Background assessment

Determine the evaluation objectives, clear the computer professional practice teaching objectives meet the employment needs of software engineers, such as training students' practical ability, innovation ability, etc. Determine the evaluation object, that is, select the appropriate group of students, is the practice teaching of this discipline is to focus on the undergraduate stage of the 6th semester to the 8th semester; Determine the evaluation scope, that is, determine the content and scope of the evaluation, such as the corresponding practical curriculum, teaching methods, practice links, etc. The degree of theoretical knowledge mastery is to evaluate the degree of pupils' grasp of theoretical knowledge concerning computer science, such as data structures, algorithms, and operating systems. In addition, practical training projects focus on the evaluation of intelligent projects to improve students 'practical ability.

2.3.2 Enter the rating

Analyzing teaching resources, that is, evaluating whether the hardware, software, textbooks and other resources needed for computer professional practice teaching are sufficient; Analyze the teachers, that is, evaluate whether the teaching ability and practical experience of teachers meet the teaching requirements; Analyze the curriculum, that is, evaluate whether the curriculum is reasonable and competent students' practical demands.

2.3.3 Process evaluation

To evaluate the experimental operation ability, that is, to evaluate the operation skills and

practical projects of students in the process of project practice, such as programming, debugging, testing, etc. The evaluation is carried out by means of practical software instructions and design practical operation demonstrations. Teamwork ability, which evaluates students' ability to cooperate with others in practical projects, such as communication, coordination, and division of labor, can be evaluated through teamwork projects and team evaluations. Autonomous learning ability, that is, the ability to evaluate students' active learning and self-improvement in practical teaching, can be evaluated through learning plans, study notes, and online learning resources. Professional skills, that is, to evaluate the professional skills mastered by students in practical teaching, such as programming languages, database management, network security, etc., can be evaluated by means of mid-practice tests, software test questions and answers.

2.3.4 Evaluation of results

Measuring innovation ability and intelligent design completion, that is, assessing students' ability to find project design problems in practical teaching, and solving project intelligent analysis problems, can be evaluated through project design, innovation experiment, competition results and other aspects. Software project management ability, that is, the ability to evaluate students in planning, organization, control and other aspects of practical projects, can be evaluated through project progress reports, project summary reports and other ways. Comprehensive quality refers to the evaluation of the comprehensive quality of students shown in practice teaching, such as professional ethics, communication skills, team spirit, etc., which can be evaluated by teachers and classmates. Achievement output refers to the evaluation of students 'achievements in practical teaching, such as software project results, subject competition extension, software copyright, etc., and can be evaluated through achievement display and achievement report.

2.3.5 Develop improvement measures

According to the findings from the evaluations of the process, backdrop, input, and output, targeted improvement measures are formulated, such as optimizing curriculum, improving the quality of teachers, and improving teaching methods. The implementation of improvement measures, and continue to pay attention to the improvement effect, constantly adjust and improve the computer professional practice teaching evaluation system. Reflection and Improvement: Assess the ability of students to reflect on and improve their own learning and practice during the practical teaching process. It can be evaluated through reflection reports, improvement plans, etc.

3. The Practice Teaching Evaluation Method of Computer Major based on CIPP-TOPSIS

3.1 Technique for Order Preference by Similarity to Ideal Solution

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is a multi-attribute decision analysis method. It obtains a comprehensive evaluation value by weighting multiple evaluation indicators. Thus, the various schemes are sorted and selected. The combination weighted TOPSIS method can comprehensively consider the importance of multiple evaluation indicators, and improve the scientific and reasonable evaluation results. TOPSIS method is simple and easy to implement, the calculation process is simple, easy to operate, and the evaluation index system and weight distribution can be adjusted according to actual needs, so it has strong flexibility and adaptability. The principle of combination weighted TOPSIS method mainly includes the following steps:

(1) Determine the evaluation indicators

According to the actual problem, appropriate evaluation indicators are selected, which can be qualitative or quantitative.

(2) Data standardization

Because the evaluation indicators' dimensions and numerical ranges change, it is necessary to standardize the data to make them comparable. The commonly used normalization methods are linear normalization, range method and so on.

(3) Determine the weights

According to the importance of the evaluation index, a weight is assigned to each index. The weights can be found using a variety of techniques, including the fuzzy comprehensive assessment approach, the entropy weight method, and the analytical hierarchy process. The combination weighting mentioned here means that multiple weight determination methods are combined to improve the accuracy and reliability of the weights.

(4) Compute the positive and negative ideal solutions

Combining the best values from each evaluation index yields the positive ideal solution, while combining the worst values from each evaluation index yields the negative ideal solution. The positive and negative ideal solutions may be used to compute the distance between each alternative and the positive and negative ideal solutions.

(5) Calculate relative proximity

Relative closeness is defined as the distance between each option and the positive ideal solution divided by the total of the distances between the positive ideal solution and the negative ideal solution, and it is used to assess each alternative's overall advantages and drawbacks.

(6) Solution ordering and selection

According to the size of the relative proximity, the schemes are ranked and the best scheme is selected.

3.2 Practice Teaching Evaluation Method of Computer Major based on CIPP-TOPSIS

The CIPP-TOPSIS method combines the CIPP evaluation model idea, and uses the combination weighted TOPSIS method to comprehensively evaluate multiple evaluation indicators of the practice process. In the practical teaching evaluation, it can be applied to evaluate the students' mastery of knowledge and the evaluation of teaching effect. The proposed evaluation method is divided into four steps:

(1) Build an evaluation index system

The foundation of evaluation is the evaluation index system. It is necessary to select representative evaluation indexes from many aspects according to the characteristics and objectives of software project training teaching. The CIPP model is established according to the key elements of the practical teaching process, including four stages: input, process, output and outcome, which can comprehensively understand the practical teaching process and set the corresponding evaluation indicators for each stage.

(2 Data collection and analysis

Data were collected through questionnaires, observation and performance analysis, and the data were cleaned and sorted out. Then, statistical methods and qualitative analysis methods are used to analyze the data to identify the problems and advantages in each stage.

(3) Determine the weight of each indicator

Weight is the basis for measuring the importance of each evaluation index, which needs to be determined according to the role and influence of each index in software project training teaching. Weight determination methods that are often employed include the analytic hierarchy process, the entropy weight method, principal component analysis, and so on. AHP is utilized in this study to calculate the weight of each index.

(4) Use TOPSIS method to rank the evaluation objects

The TOPSIS approach is a distance-based multiple attribute decision making analysis technique. Its fundamental concept is to rate the evaluation items after comparing their positive and negative ideal solutions and measuring the distance between each evaluation object and its ideal solution. The following are the steps:

(1) Determine the optimal positive and negative solutions. A positive ideal solution is one in which the values of each evaluation index reach their maximum, whereas a negative ideal solution is one in which the values of each evaluation index reach their minimum.

(2) Determine the separation between the positive and negative ideal solutions and each evaluation object.

Distance calculation formula, such as Formula (1).

$$d = (x - x^{'}) / (x_{\max} - x_{\min}) \quad (1)$$

Where x denotes a specific evaluation object index value, x' denotes the matching index values of positive and negative ideal solutions, xmax denotes the index's greatest value, and xmin denotes its minimum value. (3) Determine how close each assessment object is to both the positive and negative ideal solutions.The relative proximity calculation formula, such as Formula (2).

$$S = (d_{+} - d_{-}) / (d_{+} + d_{-}) \quad (2)$$

The evaluation object and the positive ideal solution are separated by d+, while the distance between the evaluation object and the negative ideal solution is represented by d−.

According to the relative proximity of each evaluation object obtained by TOPSIS method, each evaluation object can be sorted, so as to obtain the comprehensive evaluation results of

software project training teaching. The evaluation results are fed back to teachers and students, and suggestions for improvement are made based on the evaluation results. To guarantee ongoing enhancements in the caliber of hands-on instruction, educators and learners are urged to actively engage in the feedback and improvement process. Through the analysis of the ranking results, the problems and shortcomings in teaching can be found out, and corresponding improvement measures can be taken to improve the quality and effect of teaching.

4. Effect Analysis of Teaching Practice Evaluation

Using our school's seventh semester computer science and technology major's teaching evaluation of the software project training course as an example. The course involves 87 professional teaching personnel, and the training course lasts 3 weeks. When building the assessment index system, the demand analysis for the training project (input), project design and project implementation (process), project specification (output), and test defense (results) are selected as the evaluation indexes. The data scatter plot corresponding to this multiple evaluation index is shown in Figure 2.

Figure 2. Scatter Plot of Multi-Evaluation Index Data for Practical Courses

Data were collected through questionnaire survey, quantitative scoring of observation process and performance analysis, and the data were cleaned and sorted out. Then, statistical methods and qualitative analysis methods are used to analyze the data to identify the problems and advantages in each stage. According to the expert scores, the judgment matrix of computer practice teaching evaluation parameters is determined, as displayed in Table 1. Each index's weight is determined as 0.06, 0.13, 0.43, 0.22, 0.15 by applying the combination weighted TOPSIS method, and the CIPP-TOPSIS approach is utilized to comprehensively assess the practical teaching classes. The score interval histogram of evaluation performance is shown in Figure 3.

Table 1. Computer Practice Teaching Evaluation Parameters Judgment Matrix

	Demand analysis	Project design	Project execution	Test defense	Project specification
Demand analysis	1	2	0.125	0.5	0.25
Project design	2	1	0.5	0.5	1
Project execution	8	2	1	2	2
Test defense	2	2	0.5	1	2
Project specification	4	1	0.5	0.5	1

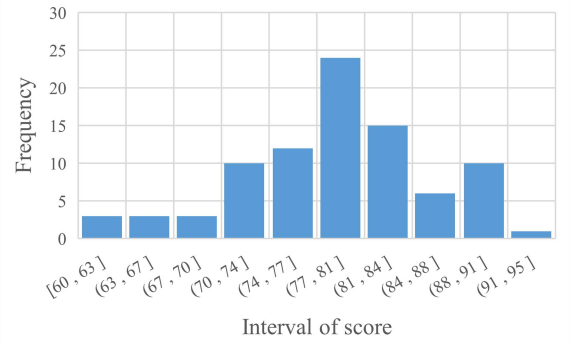

Figure 3. Histogram of Score Interval for Practical Course Performance

5. Conclusion

By applying this evaluation method to practical courses of computer science, it can be found that practical teaching performs well in some aspects, such as in the input phase and process control. However, there are still some problems in other aspects, such as the curriculum design arrangement in the output stage and the innovation cultivation in the outcome stage. According to the evaluation results, we put forward corresponding improvement measures, such as adjusting the course design content and strengthening the innovation training. The comprehensive evaluation method based on CIPP-TOPSIS presents an efficient assessment approach for computer science practical instruction. By using this approach, we may identify the issues that exist in practical teaching, gain a thorough understanding of the situation, and implement the necessary

corrective action. In the subsequent research, the topic will further explore how to apply this evaluation method to other subject areas to promote the continuous improvement of higher education quality.

Fundings

Jilin Province Education Science "14th Five-Year Plan" General Topics for 2021 (GH21237) "Research on Practical Teaching Model and Teaching Evaluation Method of Computer Majors in applied Colleges and Universities facing the demand of 'Intelligent Transformation' of new engineering".

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