Construction of a Teaching Evaluation System for Computer Network Courses under a Blended Teaching Mode

Dongmei Fan

343770458@qq.com

Shandong Xiehe University , JiNan , Shandong Province ,250000 , China

Abstract: This paper studies the construction of a multi-dimensional teaching evaluation index system for computer network courses under the blended teaching mode, which includes objectives, process, and outcomes dimensions. At the objectives level, assessment indicators for theoretical knowledge such as network knowledge and network protocol mechanisms are set. At the process level, practical skills assessment indicators such as network configuration training and network troubleshooting are established. At the outcomes level, indicators such as academic performance and learning interest are included. The study proves the effectiveness of the constructed assessment index system in the application of blended teaching mode and provides theoretical guidance for the effective improvement of blended teaching quality.

Keywords: Blended teaching mode; Computer network course; Teaching evaluation; Index system

1 Introduction

The teaching quality of computer network courses, a core subject in computer science and technology majors, directly affects students' competitiveness in the job market[1]. How to carry out a scientific and effective teaching assessment to improve the quality of course teaching is an urgent issue to be resolved. Traditional face-to-face teaching cannot meet the needs of modern educational development, and blended teaching, as a new teaching mode, has broad application prospects in computer network course teaching. However, there is still a lack of research on teaching evaluation for computer network courses under the blended teaching mode. Therefore, it is significant to construct a teaching evaluation index system suitable for the blended teaching mode of computer network courses to carry out an effective evaluation process and improve teaching quality[2].

ITEI 2023, November 24-26, Zhengzhou, People's Republic of China

DOI 10.4108/eai.24-11-2023.2343618

2 Construction of the Teaching Evaluation Index System for Computer Network Courses

2.1 Principles of Index Selection

In constructing the teaching evaluation index system for computer network courses, the selection of indicators should follow principles of scientific nature, systematicness, and operability[3]. The scientific nature principle requires that the selected assessment indicators can truly reflect the quality of teaching, are highly relevant to the course objectives and teaching process, and are measurable. Indicators should consider various aspects such as knowledge, ability, and quality, comprehensively reflecting the entire process of teaching and learning. The systematicness principle demands that the index system, as an organic whole, should completely reflect the teaching activities and effects of computer network courses. Indicators should be relatively independent yet interrelated and interdependent. The operability principle requires that the measurement of indicators should have clear standards and methods, be simple and practical to operate, and easy to implement and statistically analyze[4]. Indicators should be quantifiable, and results should be easy to judge. In the process of index selection, the characteristics of computer network courses should also be fully considered. Although theoretical knowledge is abundant, the emphasis is on the cultivation of applied skills. Therefore, process indicators should be strengthened to assess students' hands-on practical abilities.

2.2 Composition of the Index System

The teaching evaluation index system for computer network courses is generally divided into three levels: objectives, process, and outcomes. At the objectives level, indicators such as network architecture knowledge assessment and network protocol mechanism assessment can be set to evaluate students' mastery of basic theoretical knowledge of computer networks. At the process level, indicators such as network configuration experiment assessment and network troubleshooting assessment can be established to evaluate students' abilities to analyze and solve problems using their knowledge. At the outcomes level, indicators such as academic performance assessment and learning interest assessment can be set to evaluate the overall effect of teaching activities on students. In specific settings, data for indicators can be obtained through various methods such as student test scores, teacher evaluations, and self-assessment by students. Indicators at each level should be relatively balanced and closely related, collectively judging the entire process of teaching and learning[5]. This three-dimensional index system, which combines objectives, processes, and outcomes, can make a more comprehensive and three-dimensional judgment of the teaching activities of computer network courses. However, control over the number of indicators should be exercised to avoid redundancy or over-complexity. Determining Indicator Weights,The weight coefficient of each evaluation indicator is determined using the expert scoring method[6]. The specific steps are as follows:

Invite 5 teaching experts to form an evaluation expert group. The experts should have rich teaching experience and be familiar with computer network courses.Have each expert score the importance of each evaluation indicator on a 1-5 scoring scale based on their own judgment (1 indicates the least important and 5 indicates the most important).Collect all the

expert scoring results, calculate the average score for each indicator, and uniformly normalize them to the range of 0-1. The processing method is: normalized value = (original average score - minimum average score) / (maximum average score - minimum average score)The normalized value is the weight coefficient for that indicator. The larger the weight coefficient, the greater the importance of the indicator[7].

Teaching Effectiveness Evaluation Model,Establish a quantitative teaching effectiveness evaluation model to express the quantitative relationship between teaching effectiveness and the various indicators. The model is expressed as:

$$Y = w1X1 + w2X2 + ... + wn*Xn$$

Where:Y - Evaluation value of teaching effectiveness,X1, X2...Xn - Values of indicators at the target level, process level, effect level, etc.,w1, w2...wn - Corresponding weight coefficientsThrough this model, it can be clearly seen that the teaching effectiveness value is jointly determined by the various evaluation indicators and their weights. The higher the indicator data value, the greater its contribution to the teaching effectiveness. This allows direct judgment of the teaching effectiveness as good or bad, and identifies key factors affecting teaching effectiveness.The specific composition of the index system is shown in Figure 1.

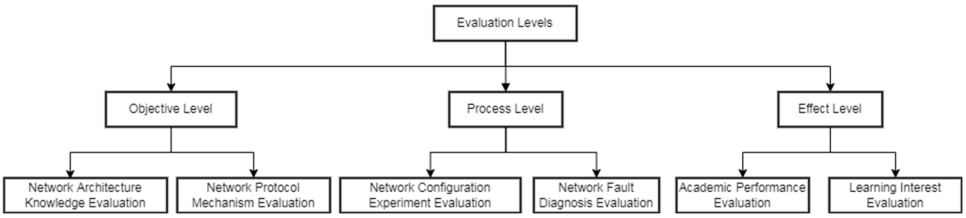

Figure 1: Composition of the Specific Index System

3 Implementation of Teaching Evaluation for Computer Network Courses Based on Blended Teaching Mode

3.1 Implementation of Teaching Under the Blended Teaching Mode

Under the blended teaching mode, the teaching of computer network courses can adopt a combination of theoretical instruction and network training[8]. Theoretical instruction can be carried out on online teaching platforms, where teachers upload teaching materials and record instructional videos for online teaching. Students learn theoretical knowledge by watching videos, studying course materials, and taking online tests. The network training part should be conducted face-to-face, with students completing operations training such as switch and router configuration in the training lab. During the training, students work in pairs with guidance and problem-solving assistance from the teacher. After the training, students submit training reports[9]. Combining these two teaching methods ensures systematic learning of theoretical knowledge while also strengthening the cultivation of practical skills such as network configuration. Theory and practice complement each other, better achieving the teaching objectives. In the implementation of teaching, teachers should reasonably arrange the time ratio and sequence of the two teaching methods and provide necessary guidance and help. At

the same time, process monitoring should be strengthened to form regular teaching evaluations and feedback. The specific teaching implementation is shown in Figure 2.

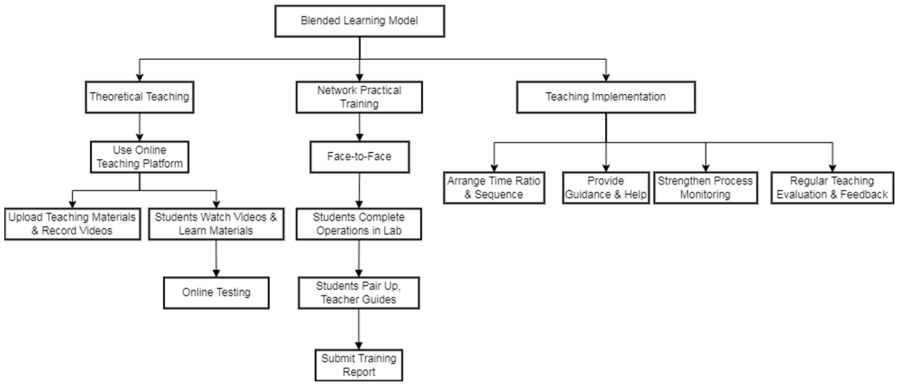

Figure 2: Implementation Diagram of Teaching under the Blended Teaching Mode

3.2 Application of the Evaluation System

Under the blended teaching mode, the teaching evaluation of the computer network course can be carried out from several aspects according to the constructed teaching evaluation index system. A process-oriented evaluation is conducted on the mastery of theoretical knowledge[10]. This mainly uses classroom tests and online tests to evaluate students' understanding of network architecture, protocol mechanisms, and other knowledge areas; A formative assessment is conducted on the ability to configure networks in training. This is done by evaluating students' performance in switch and router configuration training, examining problems encountered and their solutions during the training, and assessing the effectiveness of network configuration skill development; An analysis of final exam scores is conducted to verify the ultimate learning outcomes. Exam scores can reflect the effectiveness of the students' network knowledge structure; A summative assessment of students' learning interest and attitude is carried out to understand the overall impact of teaching activities on students. The results of the assessment should be promptly fed back to teachers and students during the teaching process to improve the quality of teaching and learning. The specific evaluation system is shown in Figure 3.

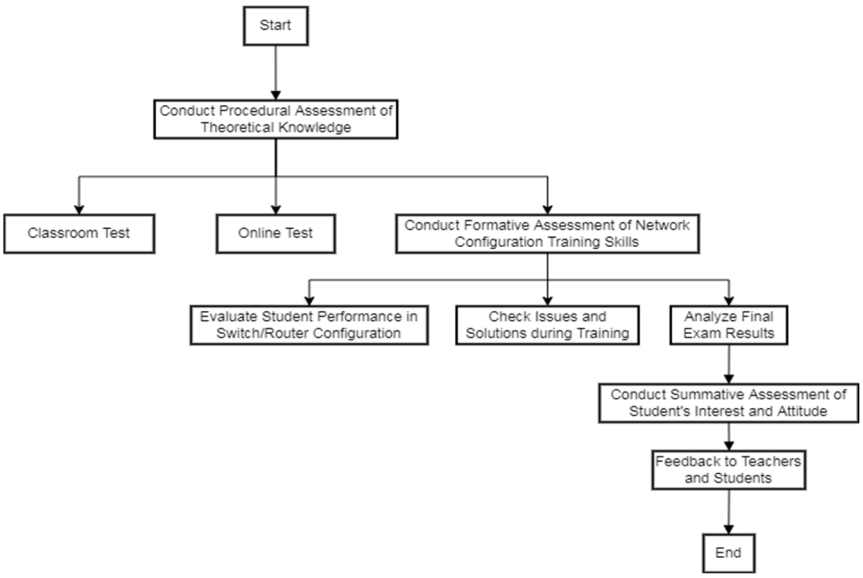

Figure 3: Evaluation System Diagram

4 Empirical Study

4.1 Research Subjects and Implementation Process

This study selected two computer network classes from the School of Computer Science and Technology at a university as the research subjects, named the experimental group and the control group, respectively. Each group consisted of 40 students, totaling 80 individuals. A pre-test on computer basic knowledge was conducted for students in both groups, and the results showed no significant difference, with the experimental group's pre-test average score being 83.5 and the control group's being 84.2, indicating comparability between the two samples. Students from both groups were from the Computer Science and Technology major of the same college, with a similar male-to-female ratio, and ages concentrated between 19-20 years old. Both groups were set with the same teaching syllabus and course content, the difference being that the experimental group used a blended teaching mode, while the control group used a traditional face-to-face teaching mode. The research process was divided into the following four steps: the first step was to conduct a pre-test on both groups before the course started to assess the basic knowledge and skills in computer networking, ensuring no significant difference between the two groups; the second step was to implement a semester-long computer network course teaching, with the experimental and control groups using different teaching modes; the third step was to conduct final assessments and questionnaire surveys on learning attitudes and interests after the teaching ended; the fourth step was to collect the obtained assessment data and use statistical methods to analyze the results of the two groups, verifying the effectiveness of the evaluation system. Detailed information about the research subjects is shown in Table 1.

Table 1: Research Subjects Table

Group	Number of Participants	Gender Ratio	Age Distribution	Faculty	Major	Pre-test Scores
Experimental Group	40	Males 25, Females 15	19 years old: 12, 20 years old: 27, 21 years old: 1	School of Computer Science and Technology	Computer Science and Technology	83.5
Control Group	40	Males 24, Females 16	19 years old: 13, 20 years old: 26, 21 years old: 1	School of Computer Science and Technology	Computer Science and Technology	84.2

4.2 Evaluation Results and Analysis

After a semester-long teaching experiment, the teaching effects of the experimental and control groups were comprehensively evaluated in terms of theoretical knowledge assessment, network configuration training ability assessment, and learning attitude questionnaire surveys. The assessment of theoretical knowledge for both groups was in the form of a closed-book written exam with a total score of 100 points, covering all knowledge modules such as computer network architecture, network communication protocols, and switching technology. The results showed that the average score of the experimental group was 82.3 points compared to 79.6 points for the control group, with a significant difference between the two groups ($p=0.026<0.05$). The network configuration training ability assessment required students to complete specific operations such as switch and router configuration, with a full score of 100 points. The results showed that the average score of the experimental group (87.5 points) was higher than that of the control group (83.2 points), with a significant difference between the two groups as well ($p=0.012<0.05$). The learning attitude questionnaire was conducted using a Likert five-point scale, including aspects such as learning interest, proactive thinking, and self-study ability. With a full score of 100 points, the average score of the experimental group was 82.4 points, compared to 77.3 points for the control group. An independent samples T-test confirmed a significant difference between the two groups ($p=0.021<0.05$). In summary, the experimental group was significantly superior to the control group in these core assessment indicators of knowledge assessment, practical training ability, and learning attitude, indicating that the evaluation system based on the blended teaching mode is effective. The main evaluation results are detailed in Table 2:

Table 2: Evaluation Results Table

Group	Theoretical Knowledge Assessment	Network Training Assessment	Learning Attitude Questionnaire
Experimental Group	82.3 points	87.5 points	82.4 points
Control Group	79.6 points	83.2 points	77.3 points
T-test P-value	0.026	0.012	0.021

5 Conclusion

The study, based on the characteristics of teaching computer network courses, has constructed a multi-dimensional teaching evaluation index system suitable for the blended teaching mode,

including objectives, process, and outcomes dimensions, and realized the specific application of this evaluation system in the blended teaching process. The research findings indicate that, compared with traditional face-to-face teaching, the application of the constructed evaluation system in blended teaching can better improve students' learning effectiveness in knowledge, practical ability in network configuration, as well as their learning interest and initiative. The research provides theoretical support and empirical evidence for the teaching evaluation of network courses under the blended teaching mode and offers a reference for the construction of teaching evaluation systems for other information technology courses. Subsequent research will continue to enrich and expand the connotations and scope of the evaluation indicators, enhance the systematic nature of the evaluation, and explore the applicability of this evaluation model in the teaching of other courses.

Project: 2022 Shandong Province Undergraduate Teaching Reform Research Project: "Computer Network" Three Sections, Three Levels, Three Questions, Three Evaluations, and Multiple Assessments "Teaching Reform Research and Practice, Project Number: M2022055

References

[1] Ge Zhenling, Shi Lianshuan, Zhao Xiaoyu. Teaching Design of "Computer Network Basics" Course under Blended Teaching Mode in Secondary Vocational Schools [J]. Computer Knowledge and Technology, 2022, 18(04):177-180.

[2] Chen Lei. Exploration of Blended Teaching Mode for Computer Network Course in Virtual and Real Integrated Environment [J]. Gansu Science and Technology, 2021, 37(19):83-85+172.

[3] Chen Jin. Exploration of Computer Network Principles Course Design under Blended Teaching Mode [J]. Wisdom, 2017(31):84.

[4] Liu Jialin. Research on the Blended Teaching Mode of "Computer Network" Course Online and Offline [J]. China New Communications, 2023, 25(15):83-85.

[5] Liu Ming, Zheng Ruijuan, Wang Yong. Practical Exploration of Blended Teaching Mode for Computer Network Course [J]. Computer Knowledge and Technology, 2023, 19(17):89-91.

[6] Han Haixiao. Application Research of the Flipped Classroom Blended Teaching Mode Based on OBE—Taking the "Computer Network" Course as an Example [J]. Modern Information Technology, 2022, 6(23):183-186+190.

[7] Wang Yingmei. Application Research of Online and Offline Blended Teaching Mode in "Computer Network" Course [J]. Technology and Innovation, 2022(17):179-181.

[8] Pei X,Tang E H. Research on Online and Offline Mixed Teaching Mode—Taking Photoshop Course in Higher Vocational Colleges as an Example[J]. Frontiers in Educational Research,2023,6(19).

[9] Geoff W ,Vinh B .Design and implementation of a smart learning environment for teaching computer networking[J].European Journal of Open, Distance and E-Learning,2023,25(1):162-179.

[10] Yaw J L ,Kwame J A ,Ebenezer O , et al.A Classical LTE Cellular System Simulator for Computer Network Education[J].Modelling and Simulation in Engineering,2021,2021.