The Construction of Evaluation System of MCU Class Courses in Universities Based on CIPP and FCE

Xiaohong Duan

Shandong Huayu University of Technology, Dezhou, Shandong Province, 253034, China

qianqiansnow@126.com

Abstract. The current development of higher education is inseparable from the professional construction and curriculum reform, and the MCU class course is a typical course for cultivating students' time competence and vocational literacy, as well as a typical course for multidisciplinary cross-fertilisation in the context of new engineering. By studying the evaluation standard based on CIPP model in the context of higher education, and constructing the evaluation system based on FCE for MCU class courses, the evaluation factors of the courses are quantitatively analysed, which is able to comprehensively and effectively evaluate the effectiveness of the construction of the courses and the validity of the quality of talent cultivation. The course evaluation results obtained through this evaluation system are reasonable and can comprehensively and effectively evaluate the effectiveness of the construction of the course and the effectiveness of the quality of talent cultivation, promote the deepening reform of the MCU class courses, improve the quality of the course evaluation results, and promote the cultivation of innovative talents.

Keywords: CIPP, FCE, course evaluation system.

1   Introduction

In recent years, the Ministry of Education has issued various notices on promoting the development of higher education, and with the development of the new generation of information technology industry, the curriculum construction in higher education also needs to accelerate the transformation and upgrading to meet the adaptability of the development of colleges and universities. Then, the evaluation system for the course is also urgently needed to meet the requirements of the cultivation of complex talents in colleges and universities.

2   The Status of MCU Courses in Universities

2.1   The Positioning of MCU Courses

In the context of deepening the reform of higher education and strengthening the curriculum construction and curriculum reform, the current reforms of MCU courses are endless, so it is especially important to evaluate the effect of curriculum construction. In particular, whether the course can highlight the cultivation of students' practical ability and engineering thinking ability, whether it meets the talent cultivation objectives, and whether it can effectively promote the cultivation of composite talents in colleges and universities[1]. Therefore, it is of practical significance to explore and construct the evaluation system for MCU courses.

2.2   The Nature of MCU Courses

MCU courses are the core courses for electronic information, Internet of things engineering and other professional courses, is in the C language, digital electricity and computer application foundation and other prerequisite courses, focusing on cultivating students to apply the knowledge of the MCU to solve complex engineering problems, has a strong theoretical and practical, high value of the application of soft and hard and other characteristics. The uniqueness of MCU determines that the course contains a large number of complex and fragmented concepts, and the basic concepts are relatively abstract[2]. These teaching contents focus on both the teaching of theoretical knowledge and the cultivation of practical operation ability.

In terms of teaching methods, MCU courses usually adopt the teaching mode of combining theory and practice, and are taught through classroom lectures, experimental operations, project design and other ways. At the same time, the teaching of MCU courses should also pay attention to the integration of heuristic teaching methods and tailored to the needs of the students, to achieve the transformation from 'teaching-centred' to 'learning-centred' to stimulate students' interest and initiative in learning, which is an important trend in the development of higher education at home and abroad. It is an important trend in the development of higher education at home and abroad.

3   Evaluation Criteria of MCU Courses Based on CIPP

First of all, in view of the nature and characteristics of different courses, it is necessary to further construct a reasonable course evaluation system and quantify the various evaluation aspects of course construction. In this paper, we mainly discuss the evaluation system of MCU courses, which organically integrates the CIPP model and Fuzzy Comprehensive Evaluation (FCE), and is able to build a more reasonable course evaluation system in an all-round way, in order to promote the reform of the course goal achievement pathway, teaching content, evaluation system, etc., so as to adapt to the requirements of the cultivation of new engineering talents in the new era.

In this way, students' practical ability and innovative spirit can be better cultivated to make them more competitive.

The CIPP model stresses that the evaluation of the curriculum should not be limited to assessing the achievement of the teaching objectives, but should be to provide useful information for the evaluation and decision-making of the curriculum and to serve the reform of the curriculum. The model consists of four main steps: Context Evaluation, Input Evaluation, Process Evaluation and Product Evaluation, which is an assessment model that can intuitively and comprehensively reflect the effect of curriculum implementation[3,4]. The evaluation criteria of the CIPP model MCU class courses can evaluate the course system more comprehensively and objectively(see Fig. 1).
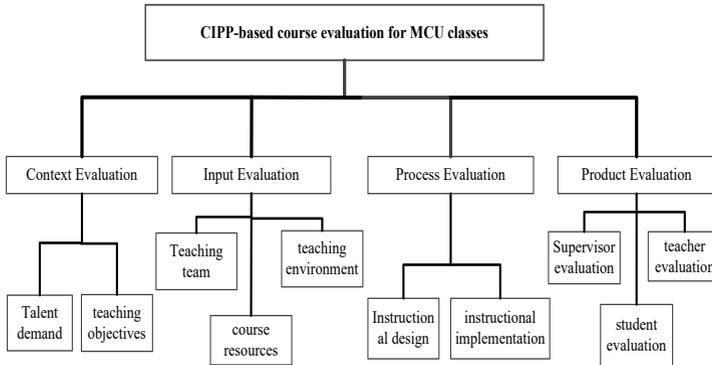
Fig. 1. Structure diagram of evaluation criteria of MCU class courses based on CIPP.

4   Evaluation System of MCU Courses Based on CIPP and Fuzzy Comprehensive Evaluation (FCE)

Fuzzy comprehensive evaluation is based on fuzzy mathematics, applying the principle of fuzzy relationship synthesis, quantifying some unclear boundaries, not easy to quantify the factors, and carrying out a comprehensive evaluation of the evaluated affairs affiliation level status from multiple factors [5,6]. In the process of constructing the evaluation system of MCU class courses, the CIPP evaluation mode of MCU class courses is introduced in the fuzzy comprehensive evaluation, and the specific steps are as follows.

4.1   Determine Evaluation Indexes

The evaluation indexes in the fuzzy evaluation system of MCU class courses based on CIPP include four first-level indexes, i.e., background evaluation, input evaluation, process evaluation, and outcome evaluation, constituting a set of evaluation indexes.

U={U1,U2,U3,U4}={Background evaluation, input evaluation, process evaluation, outcome evaluation}

The factors supporting the above four first-level indicators are the corresponding second-level evaluation indicators.

U1={U11,U12}={Talent demand, teaching objectives}

U2={U21,U22,U23}={Teaching team, course resources, teaching environment}

U3={U31,U32}={Instructional design, instructional implementation}

U4={U41,U42,U43}={Supervisor evaluation, student evaluation, teacher evaluation}

4.2   Determine the Evaluation Results

According to the evaluation indexes, the evaluation results of the MCU class courses can be derived into different levels (corresponding to the corresponding range of scores), constituting a collection of evaluation results.

V={V1,V2,V3,V4,V5}={Excellent, Good, Qualified, Qualified, Unqualified}= {90-100,75-90,60-75,45-60,0-45}

4.3   Determine the Weights of Evaluation Indicators

Five experts evaluate the evaluation indicators according to the 1~9 labelling method, and compare the importance of the indicators two by two so as to obtain the 4×4 expert judgment matrix Ai (i=1~5). The following Table 1 gives a judgment matrix.

Table 1. Importance of indicators

evaluation indicators	background evaluation	input evaluation	process evaluation	outcome evaluation
background evaluation	1	2/3	1/2	2/5
input evaluation	3/2	1	2/3	1/2
process evaluation	2	3/2	1	3/4
outcome evaluation	5/2	2	4/3	1

The weight of each indicator is calculated using the pooled average method (square root method). First, the elements of each row of the judgment matrix Ai (i=1~5) are multiplied, and then the result is squared n times to obtain a new vector. Finally, it is normalized to get the weight vector. Finally, the weight values corresponding to each evaluation index are obtained, totaling 5 sets of weight sets corresponding to 5 experts.

$$\omega_i' = \sqrt[n]{\prod_{k=1}^{n} A_{ik}} \quad ,n=1, 2, ...,5 \tag{1}$$

$$\omega_i = \frac{\omega_i'}{\sum_{k=1}^{n} \omega_{i'}} \quad ,n=1, 2, ...,5 \tag{2}$$

Due to the subjectivity of the experts in scoring and evaluating the factors of each indicator, in order to avoid logical errors, the consistency test ensures that the judgment matrix has a general consistency to avoid decision-making errors.

$$\lambda_{max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(AW)_i}{W_i}$$ (3)

$$CI = \frac{\lambda_{max} - n}{n - 1}$$ (4)

According to the judgement matrix Ai (i=1~5) constructed by the scoring of 5 experts, the weight vector of indicators ω_i(i=1~4) is obtained through the above calculation method, and the maximum characteristic root, consistency test index CI and consistency ratio CR are calculated respectively. The following Table 2 gives the specific calculation results.

Table 2. Weights of first-level evaluation indicators and consistency test results

Expert judgement	ω_i				λ_{max}	CI	CR
1	0.1413	0.1966	0.2864	0.3757	4.0032	0.0011	0.0012
2	0.1500	0.1974	0.2640	0.3885	4.0186	0.0062	0.007
3	0.1851	0.2048	0.2896	0.3205	4.0121	0.0040	0.0045
4	0.1678	0.1926	0.3156	0.3240	4.0153	0.3531	0.0394
5	0.1689	0.1318	0.3668	0.3325	4.0553	0.0184	0.0207

The calculation results show that the consistency ratio of the obtained weights, CR<0.1, have passed the consistency check, indicating that the weight calculation results of each indicator are correct and valid.

Calculate the weights of the secondary evaluation indicators and integrate the weights of the primary rating indicators and the secondary evaluation indicators.The following Table 3 gives the MCU class course evaluation system level 1 rating indicators and level 2 evaluation indicator weights.

Table 3. Weights of level 1 rating indicators and level 2 evaluation indicator weights

Level 1 evaluation indicators	Weights	Second-level evaluation indicators	Weights (ω_i)
background evaluation	0.1588	Talent demand	0.457
		teaching objectives	0.543
input evaluation	0.1996	Teaching team	0.302
		course resources	0.431
		teaching environment	0.267
process evaluation	0.2800	Instructional design	0.438
		instructional implementation	0.562
outcome evaluation	0.3616	Supervisor evaluation	0.274
		student evaluation	0.335
		teacher evaluation	0.391

4.4   Determine the Fuzzy Comprehensive Judgement Matrix

By adopting the method of expert scoring, the second-level indicators of the MCU class courses are scored to obtain the affiliation degree of the second-level evaluation indicators. According to the evaluation result grade and score, the evaluation results of the second-level evaluation indicators are obtained. The following Table 4 gives the Fuzzy evaluation results.

Table 4. Fuzzy evaluation results of second-level indicators of courses

Second-level evaluation indicators	Affiliation degree					Score	Evaluation Result
	Excellent	Good	Medium	Qualified	Unqualified		
Talent demand	0.5	0.35	0.1	0.05	0	93	Excellent
teaching objectives	0.5	0.35	0.15	0	0	93.5	Excellent
Teaching team	0	1	0	0	0	90	Excellent
course resources	0.1	0.4	0.3	0.2	0	84	Good
teaching environment	0.45	0.2	0.35	0	0	91	Excellent
Instructional design	0.4	0.3	0.2	0.1	0	90	Excellent
instructional implementation	0	0.6	0.1	0.3	0	83	Good
Supervisor evaluation	0.1	0.55	0.35	0	0	87.5	Good
student evaluation	0.25	0.45	0.2	0.1	0	88.5	Good
teacher evaluation	0	0.65	0.25	0.1	0	85.5	Good

Fuzzy operation of weight matrix and affiliation matrix by multiplication and addition operator to get fuzzy comprehensive evaluation matrix.

$$Bi=Wi \times Ri \quad （i = 1 \sim 4） \tag{5}$$

The course evaluation scores were calculated according to the formula. The following Table 5 gives the specific evaluation scores and evaluation result grades.

Table 5. Course evaluation results

Level 1 evaluation indicators	Fuzzy evaluation					Score	Evaluation Result
background evaluation	0.500	0.350	0.127	0.023	0	93	Excellent
input evaluation	0.163	0.528	0.223	0.086	0	88	Good
process evaluation	0.175	0.469	0.144	0.212	0	86	Good
outcome evaluation	0.111	0.556	0.261	0.073	0	87	Good

The affiliation matrix of the microcontroller class course for background evaluation, input evaluation, process evaluation, and outcome evaluation is obtained by calculation, and the comprehensive evaluation grade of the course is calculated as good according to the formula.

$$P=W×R=[0.402,0.368,0.186,0.044,0] \tag{6}$$

$$Q=P·V \tag{7}$$

4.5   Application Example of Curriculum Evaluation System

The construction and reform of MCU courses in five majors of Internet of Things Engineering, Electrical Engineering and Automation, Electronic Information Engineering, Robotics Engineering, and Measurement and Control Technology and Instrumentation in a university have been carried out, and a course evaluation system based on CIPP and FCE has been adopted to evaluate the construction effect of the courses(see Fig. 2).

Fig. 2. Evaluation Scores of MCU Courses in Different Majors

The evaluation system can provide objective, comprehensive and effective analysis of the construction effectiveness of MCU courses, solve the problems existing in the construction of the courses and provide ideas for the direction of course reform, so as to improve the effectiveness of the construction of the courses.

4.6   Analysis of Course Evaluation Results

By studying the evaluation results of the MCU class courses in the context of higher education and analysing the problems and advantages of the courses in terms of background evaluation, input evaluation, process evaluation and outcome evaluation, it is found that the current courses can effectively meet the current quality of talent cultivation in higher education, but they can be further optimized in terms of process evaluation and outcome evaluation to enhance the effectiveness of course teaching.

Application Example of Curriculum Evaluation System

5   Conclusion

By studying the course evaluation system based on CIPP and FCE in the context of higher education and taking the MCU class course as an example, the influencing factors of course evaluation are analysed qualitatively and quantitatively, which makes the evaluation results of the course more objective and reasonable. The evaluation system provides a direction for the effectiveness of the reform of the curriculum of MCU class and the effective evaluation of the quality of talent cultivation in higher education, and has certain rationality.

Acknowledgment

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