Research on the Quantitative Model Construction of Vocational and Technical Education Curriculum Evaluation System under the Informatization Teaching Mode

Fengnian Zhu[1*], Wei Zhang[2]

[1]*School of Management, Wuhan Technology and Business University Wuhan, China*
[2]*School of Economics and Management, Wuchang Shouyi University Wuhan, China*
[*]*Corresponding author: 76675564@qq.com*

Abstract

The implementation of the 1+X certificate system has promoted vocational and technical education of application-oriented undergraduate universities in China. Through field investigation and questionnaires, the authors analyze the difficulties faced by the traditional courses evaluation system for vocational and technical education courses under the information-based teaching mode. On this basis, this paper puts forward how to construct the quantitative evaluation system model based on the PDCA theory from the aspects of evaluation subjects' selection, construction of evaluation indexes system, determination of weight coefficients, model algorithm, feedback mechanism, etc. to improve the evaluation level of teaching quality in applied undergraduate universities.

Keywords: *Informatization teaching; Vocational and technical education; Evaluation system; PDCA theory; Model construction*

1 INTRODUCTION

The Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020) emphasized the importance of education informatization, and listed "the construction of education informatization " as one of the ten critical projects. In 2019, the State Council issued the Notice on the Implementation Plan of the National Vocatio*nal Education Reform*, which pointed out that "China should develop the 1+X certificate system, by encouraging ordinary universities with conditions to open practical technology courses and to establish the quality evaluation system of vocational education based on the cooperation of university-enterprise". In 2020, the State Council issued *the Overall Plan for Deepening the Reform of Education Evaluation in the New Era*, which again proposed that applied universities should explore the establishment of courses evaluation criteria highlighting the cultivation of professional capability and practical application capability. In response to the above government policies, applied undergraduate universities have offered a number of vocational and technical education courses relying on the information-based teaching platform. So how to evaluate the quality of these courses is a crucial question.

With the pilot of the 1+X certificate system in applied undergraduate universities, many scholars began to pay attention to establishing a quality evaluation system of vocational education curriculum. The PDCA theory called Deming cycle is a quality management model, including Plan-Do-Check-Action four circulating repeated steps. The application of the PDCA theory to the curriculum quality evaluation system plays an important role in improving the teaching quality. However, there is seldom research on the combination of the PDCA theory and the evaluation system of courses. Based on the PDCA theory, Xuebin Feng and Anran Du (2019) discussed how to improve the teaching quality in the construction and implementation of teaching evaluation system through empirical research on Inner Mongolia Agricultural University[1]. Wenli Zhang (2014) took Guilin Tourism College as an example to study the improvement measures of the teaching quality monitoring system of higher vocational colleges based on the PDCA theory[2]. Jie Qiao, Fangfang Li and Yun Gao (2020) explored how the PDCA theory could be applied

B. Fox et al. (Eds.): IC-ICAIE 2022, AHCS 9, pp. 1447-1453, 2023.
https://doi.org/10.2991/978-94-6463-040-4_216

to the teaching quality evaluation system of universities[3]. In summary, the research on the application of PDCA theory to the courses evaluation system is still in the primary stage. There are few studies on further constructing the evaluation indexes system of a specific course based on the PDCA theory. Through field research, the authors study how to establish an evaluation system for vocational and technical education courses based on the PDCA theory under the information-based teaching model, which will help promote the pilot work of the 1+X certificate system in applied universities.

2 THE DIFFICULTIES FACED BY THE TRADITIONAL CURRICULUM EVALUATION SYSTEM UNDER INFORMATIZATION TEACHING MODE

Under the information-based teaching mode, it is found that application-oriented universities will face a series of difficulties in evaluating vocational and technical education courses in the traditional curriculum evaluation system, which are embodied in the following points:

2.1 *Relatively single evaluation subject*

When universities evaluate the teaching quality of a course, they usually synthesize the evaluation results of students, colleges and supervisors. At the end of each semester, each university calculates the evaluation scores according to different weights, of which the students' weight accounts for more than 60%. Generally speaking, the subject of current courses evaluation is still students. Because the students themselves are participants in the class, while grading the courses, they may be influenced by many subjective factors, such as being criticized or praised by the teachers. Under the information-based teaching mode, students may give low or high evaluation scores due to some objective factors, such as the quality of the informatization teaching platforms. In a word, it is difficult to reflect the real teaching quality due to over-reliance on a single evaluation subject.

2.2 *Unreasonable evaluation indexes and weights*

Through field investigation, it was found that although the teaching effects of some classes varied greatly, the evaluation results may be consistent according to the traditional evaluation system. The current evaluation system did not truly reflect the teaching quality of the curriculum. There are several reasons for this problem. One of the main reasons is that the evaluation indexes are not reasonable. A few evaluation indicators, including teaching objective, course content, teaching design, teaching ability, course testing, etc., are too abstract to measure by the evaluation subjects. The other main reason is that the weights setting is not scientific. The weights allocated to each evaluation index are equal, which doesn't reflect objective-oriented evaluation principles. Since the evaluation results calculated through the current weights were almost indistinguishable, it is difficult to detect problems in teaching.

2.3 *Poor information collection channels*

Traditional courses evaluations primarily collect evaluation information through questionnaires. This cumbersome method increases not only the errors but also the time for data statistics. Under the 1+X certificate system, the information-based teaching mode is prevalent in the vocational and technical education courses of applied universities. Traditional information collection channels are difficult to adapt to the reform of teaching models, so it is necessary to explore more efficient information collection channels according to the information-based teaching platform of universities[4].

2.4 *Lack of Feedback function for evaluation results*

The disadvantage of the traditional evaluation system is that universities only pay attention to the results of the courses evaluation. At the end of each semester, the universities would organize to evaluate the teaching quality of the courses. Then the universities would notify the classes that do not up to standards and the teachers who fail to pass the assessment. Due to lacking of results feedback mechanism, universities would not provide specific information of courses evaluation to teachers. Therefore, teachers can't improve teaching quality through data mining of the evaluation information.

3 QUANTITATIVE MODEL CONSTRUCTION OF VOCATIONAL AND TECHNICAL EDUCATION COURSES EVALUATION SYSTEM UNDER INFORMATIZATION TEACHING MODE

In the information-based teaching mode, the traditional evaluation system is not appropriate for the teaching evaluation of vocational and technical education courses, so this paper proposes the quantitative model construction of courses evaluation system of diversified subjects based on the PDCA theory, which have the following points:

3.1 *Select diversified evaluation subjects*

Under the 1+X certificate system, the goal of the vocational and technical education is to provide skilled talents for enterprises, so universities should ask all relevant parties, not just students, whether the courses achieve the teaching objectives.

Therefore, universities should select diversified evaluation subjects, such as employers, graduates, course students, and university teaching departments[5]. Evaluating the quality of the curriculum from different subjects' perspectives is helpful for the evaluation process to be open and transparent. Meanwhile, other evaluation subjects' opinions can improve the compatibility of course contents with the needs of enterprises by forcing teachers to optimize the course designs continuously.

3.2 *Reconstruct evaluation indexes and weights based on the PDCA theory*

For vocational and technical education courses, universities should build an information-based teaching evaluation system model based on the PDCA theory from the aspects of evaluation indicators, weights setting and model algorithms:

3.2.1 Construct multilevel evaluation indexes system based on the PDCA theory:

When evaluating the vocational and technical education courses of informatization teaching, according to the PDCA theory, applied universities can construct four main evaluation indicators from the following dimensions: course setting (Plan), course implementation (Do), course examination (Check) and course optimization (Action).

In the information-based teaching mode, the evaluation dimensions of the vocational and technical courses should be broadened by increasing evaluation indicators such as enterprise demands, informatization teaching technology, and information mining. Meanwhile, to improve the validity of the evaluation system, it is necessary to decompose each first-level index into 2-4 second-level evaluation indexes according to the factors analysis method.

First of all, course setting (Plan) is not only the premise of realizing the talent training plan, but also the primary factor of determining the quality of the curriculum. When setting up the courses, universities should formulate clear teaching objectives, select an appropriate information-based teaching platform, and arrange courses reasonably according to the job needs of the enterprises and the development of the industry.

Second, course implementation (Do) is essential to ensure the quality of the curriculum. Appropriate teaching content, effective teaching methods and diversified information-based teaching tools can improve the teaching quality of the curriculum. For vocational and technical education courses, it is more beneficial to improve the teaching quality from the following aspects: firstly, universities should pay more attention to the courses' practicality[6]. Secondly, teachers should adopt interactive teaching methods, such as case teaching method, group discussion method, etc. Thirdly, it is necessary to construct online simulation courses through virtual simulation technology, network interactive technology and other auxiliary means.

Third, course examination (Check) is a test of the results of course teaching. Rather than academic courses, vocational and technical teaching courses emphasize ability examination. With the help of an informatization platform of course examination, universities can comprehensively evaluate students' performances by collecting opinions from various entities such as enterprises, rather than relying solely on written examination scores.

Finally, course optimization (Action), the last dimension in the curriculum evaluation system, would ensure the circulated progression of the courses evaluation system. One of the reasons why the results of the courses evaluation are very important is that the results themselves play a role in measuring the quality of the courses. Another reason is that teachers can easily find the teaching problems through the course quality reactions, thereby improving the quality of teaching in the next stage.

In total, the multilevel indexes evaluation system is composed of 4 first-level indicators and 12 second-level indicators based on the PDCA theory. As shown in Fig 1.

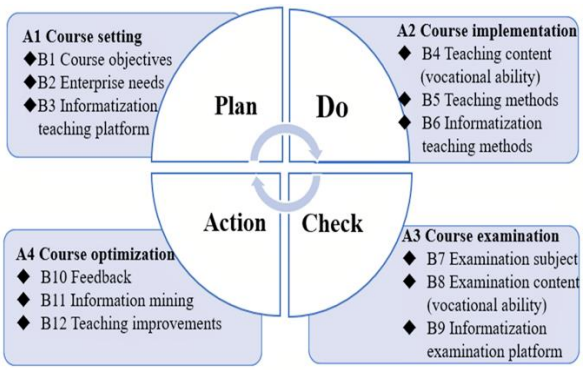

Figure 1. Architectural diagram of PDCA theory courses evaluation system

3.2.2 Determine the index weight coefficients

From three applied undergraduate universities of Wuhan Technology and Business University, Wuchang Shouyi University and Wuhan College, selecting 12 experts in research fields related to vocational education, the authors used the Delphi method to set multilevel indicator weights of the courses evaluation system. The specific steps and results are as follows:

TABLE I. The result of the first round of questionnaire

Primary Index	Weights
A1 Course setting	17.50%
A2 Course implementation	50.42%
A3 Course examination	18.33%
A4 Course optimization	13.75%
Total	**100%**

TABLE II. The result of the second round of questionnaire

Primary Index	Weights	Secondary Index	Weights
A1 Course setting	100%	B1 Course objectives	27.92%
		B2 Enterprise needs	50.42%
		B3 Informatization teaching platform	21.67%
A2 Course implementation	100%	B4 Teaching content (vocational ability)	49.17%
		B5 Teaching methods	33.75%
		B6 Informatization teaching methods	17.08%
A3 Course examination	100%	B7 examination subject	20.00%
		B8 examination content (vocational ability)	48.75%
		B9 Informatization examination platform	31.25%
A4 Course optimization	100%	B10 Feedback	50.00%
		B11 Information mining	26.67%
		B12 Teaching improvements	23.33%

TABLE III. The final indexes weights in curriculum evaluation system

Primary Index	Weights	Secondary Index	Weights
A1 Course setting	17.50%	B1 Course objectives	4.89%
		B2 Enterprise needs	8.82%
		B3 Informatization teaching platform	3.79%
A2 Course implementation	50.42%	B4 Teaching content (Vocational Ability)	24.79%
		B5 Teaching methods	17.02%
		B6 Informatization teaching methods	8.61%
A3 Course examination	18.33%	B7 examination subject	3.67%

		B8 examination content (vocational ability)	8.94%
		B9 Informatization examination platform	5.73%
A4 Course optimization	13.75%	B10 Feedback	6.88%
		B11 Information mining	3.67%
		B12 Teaching improvements	3.21%
Total	**100.00%**	**Total**	**100.00%**

a) The first step: the first round of questionnaires. 12 experts assigned weights to the four primary indexes respectively, with a total weight of 100%.

b) The second step: the results of the first round of 12 questionnaires were aggregated and fed back to the experts. All 12 experts approved the results, as shown in Table I.

c) The third step: the second round of questionnaires. 12 experts allocated weights to the secondary indexes. The specific allocation method was: according to the subordinate first-level indicators, 12 secondary indicators were divided into 4 groups, of which B1-B3, B4-B6, B7-B9 and B10-B12 were each a group. Then each group had a weight of 100%, which was distributed among 3 secondary indicators.

d) The fourth step: the comprehensive results of 12 questionnaires in the second round were reacted to the experts. There was no objection. Table II shows the weights distribution results for each group of secondary indicators.

e) The fifth step: to obtain the final weights of the secondary indicators in the curriculum evaluation system, the authors multiplied the weights of the secondary indexes in Table II by the corresponding weights of the primary indexes in Table I. As shown in Table III.

3.2.3 Model algorithms

Each participant in the course evaluation can conduct a quantitative evaluation according to the above evaluation indexes and weights. The algorithms are as follows:

a) Each evaluation subject gives its own courses evaluation score according to the formula (1):

$$A = \sum_{i=1}^{n=12} (B_i \times W_i) \tag{1}$$

A- the evaluation score of the teaching quality of the single evaluation subject;

B_i- the score of the i-th secondary index of a single evaluation subject;

W_i- the i-th secondary index weight of the curriculum evaluation system retrieved from Table III.

b) the final quality evaluation result of the course is weighted calculated as formula (2):

$$Z = \sum_{j=1}^{n} (A_j \times D_j) \tag{2}$$

Z-the final evaluation score of teaching quality of a course;

A_j- the evaluation score of the teaching quality of the course by the j-th evaluation subject;

D_j- the j-th evaluation subject accounts for the weight of all evaluation subjects.

Before using the above algorithms, it is necessary to transform the qualitative evaluation of the indexes to the quantitative evaluation scores of the above formulas by *the teaching quality scoring table* issued by each university.

3.3 *Build a collecting and processing information platform*

Under the current severe employment situations, applied universities have to improve the employment-abilities of graduates. Thus, it is essential to dynamically adjust the course content according to the job needs of enterprises, which is conducive to enhancing the practicality of technical education courses. How to acquire the job demands information instantly for universities? Universities could find the employment needs by analyzing the courses evaluation information of enterprises and other parties. Therefore, for the vocational and technical education courses, universities must build a platform to collect and process evaluation information to improve the speed of acquiring the effective information.

3.4 *Establish an immediate feedback mechanism*

According to the PDCA theory, the feedback of evaluation results is not only the last step of the courses evaluation but also the beginning for the next courses evaluation[7]. Such a cyclic progressive evaluation approach is more helpful to improve the quality of teaching. Establishing an immediate feedback mechanism can both strengthen the communications between the evaluation subjects and escort the effect of the evaluation system. Based on the teaching platform, universities can build both information collection channels and courses quality feedback channels. The instant feedback mechanism can help the subjects monitor the quality of classes at any time, discover problems in course teaching in time, and provide suggestions for the next stage of teaching.

4 CONCLUSIONS

In summary, under the informatization teaching model, exploring the model construction of the evaluation system of vocational and technical education courses in applied undergraduate universities will help promote the pilot work of the 1+X certificate system. Through field research, the authors found that because the traditional courses evaluation system existed a few of problems such as a single evaluation subject, unreasonable courses system, poor information collection channels, and lack of feedback function, it was not suitable for the vocational and technical education courses. This paper proposes how to construct the quantitative evaluation system model of vocational and technical education courses from the aspects of diversified evaluation subjects, indexes and weights setting, channels collected information, and feedback mechanism for evaluation results. The innovation is the settings of the multilevel indexes and weights based on the PDCA theory and the establishment of the quantitative model. In summary, this paper provides a reference for the construction of the evaluation system of vocational and technical teaching courses in applied undergraduate universities.

ACKNOWLEDGEMENT

This paper is financially supported by the 2020 Scientific Research Planning Project of the Fifth Council of Chinese Society of Technical and Vocational Education (Project No.2020B0592) "Research on the course-certificate integrated curriculum system construction of application-oriented undergraduate universities under ‘1+X’ certificate system"

REFERENCES

[1] X. Feng and A. Du, "Study on industry-education integrated evaluation system and monitoring of applied universities: a case of Inner Mongolia agricultural university," Journal of Modern Vocational Education, no.35, pp.46-47, 2019.

[2] W. Zhang, "Research on the improvement of teaching quality monitoring system of higher vocational colleges based on PDCA cycle Theory," Guangxi Normal University, 2014.

[3] J. Qiao, F. Li and Y. Gao, "Application of PDCA in college teaching quality evaluation system under the big data background," Journal of Information and Computers, vol.32, no.24, pp.211-212, 2020.

[4] C. Zuo, "Construction of teaching quality monitoring system in applied university under information technology environment," Proceedings of the 2018 8th International Conference on Management, Education and Information, vol.163, pp. 1106-1110, Sep. 2018.

[5] L. Zhu, L. Zhuang and F. Cao, "Application of PDCA circular method in continuous improvement system of teaching in universities," Journal of Technology Horizons, no.25, pp.60-61, 2021.

[6] S. Liu, et al., "Construction of teaching quality monitoring system in application-oriented undergraduate colleges," Proceedings of the 2019 4th International Conference on Distance Education and Learning, pp.93-98, May. 2019.

[7] Y. Guo, et al., "Continuous improvement of industrial engineering education based on PDCA method and structural importance," IEEE International Conference on Industrial Engineering and Engineering Management, pp.311-315, Dec. 2018.