

Principles and Methods of Determining Practical Teaching Performance Evaluation Index in Higher Vocational Colleges

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Keywords: practical teaching; performance evaluation; index determination; principle and method

Abstract: The teaching of higher vocational colleges include theoretical and practical teaching. Only by comprehensively understanding and analyzing the indexes influencing the performance of practical teaching in higher vocational colleges can the effective and reasonable performance evaluation system be formulated. This paper, on the basis of putting forward problems existing in practical teaching in higher vocational colleges, discusses the principle, the construction and method determining the weight.

In recent years, higher vocational education has vigorously developed, so there are more and more higher vocational colleges with the objective of cultivating technicians required by enterprises. At the same time, with the fiercer competition among colleges, how to improve their competitiveness has become the key problem to be solved urgently. It is necessary to pay attention to how to enhance the teaching quality of colleges and the cultivation of students' professional ability and skills, which are mainly completed in each stage of practical teaching. The quality of practical teaching directly is related to comprehensive quality of higher vocational graduates, so how to enhance the quality of practical teaching and students' occupational overall ability is the key for higher vocational colleges to win the competition. Therefore, in order to enhance the overall quality of practical teaching, improve students' practical ability and promote the characteristic development, it is necessary to study the establishment and implementation of performance evaluation system of practical teaching in higher vocational colleges.

Higher vocational colleges shall enhance the overall quality of practical teaching and train students with high comprehensive quality and strong practical skills, which is not only the requirement of society and the direction of market demand. The research also adapts to the reform of current employment system. Due to the popularization of higher education, the number of talents trained increases. In fierce talent competition, graduates with strong practical ability and comprehensive quality are favored by enterprises. Therefore, to enhance the quality of practical quality, implement the research on performance evaluation and establish evaluation system has become the important task faced by higher vocational colleges to be urgently completed.

For most high vocational colleges, teaching program, management, evaluation and supervision are led the academic administration, and the principal in charge of teaching. There are few independent teaching evaluation institutions to supervise and evaluate specific practical teaching, and permanent departments to manage of practical teaching.

1. Problems of Practical Teaching in Higher Vocational Colleges

1.1 The lacking cultivation of students' comprehensive ability

In the process of practical teaching, the guidance by professional teachers in practice is all about professional technologies, even the simple explanation of specific tasks. Students' independent ability of working and application cannot be trained, let alone their ability of adapting to society, coordination and innovation. Besides, in completing the task, the management is poor, so some students just copy and lack the awareness of quality and sense of responsibility. The practical teaching fails to pay sufficient attention to students' comprehensive ability, so that students cannot apply their knowledge into practice and they still need to learn again in the future.

1.2 The formalized practical teaching process

Higher vocational colleges focus on practical teaching, however, compared with theoretical teaching, they are more inclined to practical teaching in teaching program and hours, courses such as experiment, internship and curriculum design even accounting for more than a half of courses. Whereas, the teaching, management and evaluation of practical teaching are formalized. The reform on practical teaching has been carried out by many higher vocational colleges, however, it is limited by the inadequate teachers and places, uneven or scattered internship bases. Thus, it is just formalized and fails to reach a certain depth, which cannot ensure the effectiveness of students' practical learning and causes unsystematic professional skills.

1.3 The unstandardized evaluation and unsatisfactory results of process and follow-up

In practical teaching, it is necessary to establish standardized evaluation method, conducive to its effective implementation. With the increasing higher vocational colleges, there is difference in their management of practical teaching. Some colleges establish standardized system, on the contrary, some colleges fail to form standardized evaluation method or lack to carry out it. The not-in-place management and supervision of practical teaching cannot realize the evaluation of students' practical teaching, simply grading the results or even ignoring illegal operations and behaviors violating requirements. In addition, students have insufficient understanding of the importance of practical teaching, lacking necessary pressure and emphasis, which affects the results of practical teaching.

1.4 The backward management system of off-campus practical teaching

When selecting off-campus training bases for students' practical teaching, under the pressure of environment and conditions, even higher vocational colleges have formulated corresponding management method, enterprises fail to sign cooperation training agreement with colleges and students, offer the reasonable and standardized management and let alone formulate the teaching contents of specific practice and the quantitative evaluation in stages, procedures and grades, according to the nature of courses. In this way, it is in chaos, students become the bystander of work, and practical results are unsatisfactory and formalized. Thus, the significance of practical learning cannot be realized.

1.5 The deficiencies in performance evaluation system

With the higher status and larger proportion of course hours, practical teaching is not fully emphasized by higher vocational colleges, lacking in-depth study on performance evaluation. Practical teaching is still formalized. The performance evaluation system is to evaluate the quality of practical teaching in qualitative and quantitative way. Yet, the diversified and flexible organization of practical teaching contents make it difficult to establish the teaching results assessment and performance evaluation system. It is now still in the exploratory and beginning stage, and there is inevitably a certain inadequacies and drawbacks, including the lack of scientific evaluation method, the current single method that pays more attention to results not process, and the quantization of evaluation indicators by experience or simple calculation, even the different evaluation standards and the evaluation from teachers by expressions. Thus, it is imperative to establish reasonable, standardized and scientific performance evaluation system, and complete relevant evaluation indicator to assess students' practical teaching in the entire process and effectively make use of resources.

2. The Definition of Performance Evaluation Index and Principle

The reasonable and effective performance evaluation of practical teaching is the weak link and difficult point of practical teaching in higher vocational colleges.

2.1 The definition of performance evaluation index

The teaching of higher vocational colleges include theoretical and practical teaching, whereas,

the performance of practical teaching is only about practical teaching. Wang Yongbin holds that teaching performance refers to the realization of teaching objectives by teachers in teaching process and the application of teaching resources.

Evaluation index refers to the scale to measure the angle and dimension. The performance evaluation, taking the teaching resources, teaching equipment, fund investment, the investment of enterprise-university cooperation and other investments as the measurement standard, refers to the proportion obtained after analyzing index system, such as talent cultivation, the construction of practical teaching system, social evaluation, and enterprise-university cooperation output. It can describe the performance of practical teaching, laying a solid foundation for the index system of quality evaluation of practical teaching.

2.2 Principles of performance evaluation index system

Only by comprehensively understanding and analyzing the indexes influencing the performance of practical teaching in higher vocational colleges can the effective and reasonable performance evaluation system be formulated. The necessary procedure before the design is the requirements for determining index system, and the principles provide standard for the system, which are presented.

2.2.1 The goal-oriented principle

The goal-oriented principle is to adopt system principle and system analysis method to guide decision-making activities. The basic requirements of system principle for decision-making are shown. First of all, any decision shall begin with the integrality of system, taking various elements and conditions involved in the entire system and related systems into consideration, and the correlation of these elements and conditions. Secondly, the decision-making object shall be studied as dynamic and systematic development, because the future development of everything is the overall development of the system. Thirdly, the hardware of decision-making, or the system component, shall meet the system principle.

Higher vocational colleges shall start from their characteristics to design performance evaluation index system of practical teaching according to characteristics and requirements of talent cultivation. It shall adapt to the teaching rule and reflect the objective of national education guidelines that are followed and served by corresponding quality standard and school-running requirements and direction of general higher vocational colleges.

Modern decision-making system is mainly constituted by information, consulting, betting, execution, supervision and feedback system with their own unique functions. Decision makers can realize the overall and comprehensive decision-making by well applying the system principle. Scientific decision-making cannot be realized just from a certain part, index or link.

2.2.2 The scientific principle

The scientific principle is that decision-making activities shall follow scientific decision-making process. Under the guidance of scientific decision-making theory, scientific thinking shall be adopted. Compared to experience decision-making, its main characteristics are comprehensive, rapid and accurate information, scientific, timely and correct prediction, right direction and clear objective, complete and independent scheme, sufficient argument and appropriate analysis, clear and reasonable implementation procedure, clear responsibility and specific requirement, proper regulation and timely feedback.

When establishing index system, it is necessary to perform scientific design suitable for teaching rule, clarify the aspect, connotation and significance reflected by each index, and further promote the reasonable evaluation standard and scientific system design. Each index shall be independent so that it can reflect problems independently. While completing the work in every stage, it is necessary to focus on scientific and feasible evaluation, then further integrate effectiveness and reasonability into the setting of evaluation index.

The scientific decision-making is accurate, strict, objective and reliable, suitable for solving various new problems with multiple variables and large system. With the greater development of modern society, faster changes and wider influence, new situations and problems appear constantly,

and the integrity of economic, scientific and technological development requires the scientific principle that shall be followed in decision-making.

2.2.3 The feasible principle

The feasible principle is to measure whether the decision-making is feasible from manpower, material resources, financial resources and science and technology. The decision-making cannot be feasible if it cannot be realized from the external or internal conditions of enterprises. The purpose of decision is the application. If the decision cannot be applied, it is non-scientific decision without value, which is of no applicable significance.

In establishing index system, the selection of each index shall be easy in application, proper in number, quantized and convenient, effective and reasonable, clear in structure, and adequate in information, easily to be understood.

2.2.4 The comparability principle and system principle

The comparability principle shows that element information involved in practical teaching shall be comparable. The same or similar matters in the same practical teaching at different stages cannot be randomly changed by adopting the unified evaluation method, to ensure the comparable evaluation. If it is necessary to change, it shall be mentioned in notes. The system principle requires the teaching to be orderly, systematic and coherent, which is the teaching principle proved repeatedly in long-term teaching. According to modern pedagogy, the orderly, systematic and coherent teaching is necessary because the scientific knowledge learnt and taught are related logically and internally. Students' recognition activities shall be from unknown to new; the development of students' intelligence and learning ability is also orderly. If the teaching cannot be performed correspondingly according to a certain order, it will betray the objective law of teaching. Pragmatic teaching theory conducts an experiment and puts forward the activity-oriented and problem-oriented teaching that do not follow the logic system of subject. The experimental results show that if the system and coherence is fully betrayed, students can just obtain pieces of knowledge, resulting the decline of teaching quality, at the same time, students' intelligence cannot be systematically trained.

When establishing performance evaluation system, index elements shall be compared horizontally and vertically. Besides, it is necessary to clarify evaluation objective, the establishment of evaluation system shall adhere to the method of system analysis and appropriately deal with various relationships among elements, which is an organic integrity formed for a common objective, thus, it is organized and layered. It requires that the performance evaluation system shall be established stably and progressively according to procedures and rules.

2.2.5 The operability and authenticity principle

The principle of operability requires students to operate by themselves with their hands and brain in teaching to master labor technical knowledge and skills, and to develop operational capabilities. The actual operation is characterized by the connection between thinking and operation. This principle can consolidate technical knowledge, develop operational skills and techniques, develop cognitive abilities and creative talent, cultivate emotions, and exercise will, including designing before doing, planning the operation steps, preparing the tools, calculating and saving raw materials, saving operation time, paying attention to accuracy and precision, correcting deviations early, and adopting or quickly changing to reasonable plans.

The principle of authenticity refers to the evaluation of classroom teaching, especially the effect of students' learning. In the real evaluation, evaluation is a common task for teachers and students. It emphasizes the evaluation of students' development in real life. Authenticity evaluation should include real tasks, that is, real life activities, performance or challenges that experts in a particular field may encounter. In this process, student is no longer the passive subject, but actively participates in the evaluation activities. Students' participation in evaluations (including peer evaluation or self-evaluation) is a form of students' learning.

When setting various evaluation indicators, the indicators shall be implemented, the definitions

of the indicators should be clear and unambiguous, not vague, so that the data collection of indicators can be easily ensured. The selection of the evaluation method should be reasonable so that the results can reflect the authentic results.

2.2.6 The principle of combining emphasis and comprehensiveness

The comprehensive evaluation is to consider the evaluation project as an organism and pay attention to the overall content. The collection of evaluation information should be authentic, accurate and comprehensive, and adhere to the integrity of the evaluation information. This requires us to collect information from diversified, multiple channels and perspectives.

When determining the evaluation project, it is necessary to clearly evaluate the relationship between the projects, which can effectively reflect the comprehensiveness of the practical teaching, and also highlight the importance of key projects and links. According to the influence on the quality of practical teaching, the weighted values corresponding to the different influencing factors and evaluation items shall be given.

When establishing evaluation indicators, it is necessary to first pay attention to operability, concentrate main efforts on grasping the main problems, solving the main contradictions, and highlighting the guidance quality, that is, clearly evaluate what, how to evaluate, and what role this evaluation plays. The system must focus on the key points, guide the direction, and consider the differences.

3. The Establishment of Evaluation Index and Determination of Weight

3.1 The evaluation index

Practice teaching is one of the important teaching activities in higher vocational colleges, which embodies the characteristics of higher vocational education. The correct evaluation of the performance of practical teaching in higher vocational colleges can not only guide and supervise students, but also enable them to pay attention to practical teaching and ensure the quality of practical teaching in higher vocational colleges.

The effectiveness of the results of practical teaching performance evaluation depends on the scientificity of the evaluation system. However, to build the evaluation system as completely as possible, it is necessary to first establish each indicator of the evaluation system correctly, which forms the organic integrity and further the evaluation index system of practical teaching. Each evaluation index reflects the practice teaching in higher vocational colleges from a certain aspect. Each independent indicator needs to complement each other, constrain and correlate each other to form the best combination of indicators, so as to optimize the index system as much as possible. If the index system is not scientific and reasonable enough, the scientificity and reasonability of the evaluation results will be questioned by people. Therefore, only by establishing scientific and reasonable evaluation index can the quality of the performance evaluation of practical teaching be guaranteed.

3.2 The establishment of evaluation index

3.2.1 The preparatory stage

In this stage, to prepare for the practical teaching, including extensively collecting and studying literature and materials; in-depth combing the relevant theories of practical higher vocational colleges for practical teaching evaluation; visiting and consulting relevant personnel; preliminary understanding the practical teaching and learning in general higher vocational colleges; evaluating the performance evaluation of practical teaching.

3.2.2 The stage of empirical investigation

At this stage, it is mainly to prepare questionnaires that meet the actual situation, complete the survey of relevant questionnaires, conduct statistics and analysis on the results of the questionnaires, and modify the questionnaires according to different situations in statistics and analysis.

3.2.3 The stage of studying and proposing system

At this stage, the weight factor judgment table method and the expert consultation method (Delphi) method are mainly used to analyze the data results of the work including the questionnaire and to formulate the relevant index system. At this stage, through the analysis of relevant literature, and the results of the questionnaire survey, the primary selection and formulation of evaluation indicators are performed; the weight of evaluation indicators at each level is given, and the entire performance evaluation system is initially established and formed.

3.3 The determination of weight

The method to determinate the weight of index system can be divided into subjective and objective assignment.

3.3.1 The subjective evaluation method

The subjective evaluation method, that is, the original data for calculating the weight, is mainly obtained by the evaluator through subjective judgment based on experience, such as subjective weighting method, expert survey method, analytic hierarchy process, comparative weighting method, multivariate analysis method and fuzzy statistical method.

After the construction of the specific evaluation indicators, it is necessary to adopt the expert's evaluation and the weight factor judgment table to determine the weight of each indicator. The specific procedures are presented.

First of all, evaluation experts in various fields and relevant personnel are invited to form an expert group to evaluate the weight of the evaluation, and explain the concept and order of weight and the method of recording the weight.

Secondly, the table of evaluation indicators is prepared, and a range of weights corresponding to each evaluation factor expressed by the scoring method is given.

Thirdly, the organization expert fills in the weight factor judgment table. In specific, each expert puts a mark on each weight of each column and compares the marked columns item by item, re-marks the scores that are inconsistent with their opinions until it is satisfied. The scores for each factor are summed and the score for each variable is divided by this sum, then the result is the weight of each evaluation factor.

Fourthly, calculate the weights of the factors filled. The average weight of each evaluation factor is obtained by centralizing all weights. List the average of each factor and get the weight of each factor. Finally, the factor in a row is compared with factors in each column, and the importance of each factor is arranged in turn. The scores are successively decremented, and are divided into very important indicators, important indicators, general indicators and less important indicators.

3.3.2 The objective evaluation method

The objective valuation method, that is, the original data for calculating the weight is obtained from the actual data of the evaluation index in the evaluation process, such as the entropy weight method, the principal component analysis method, and the CRITIC method.

3.3.2.1 The entropy weight method

Generally speaking, the smaller the weight of the entropy index is, the greater the change of the index value, and the more information it provides. The greater its role in the comprehensive evaluation, and the greater its weight. It is on the contrary with the entropy weight method.

The procedures of weighting are presented. There are m schemes to be evaluated and n evaluation indexes to form the original index data matrix $X = (x_{ij})_{m \times n}$. For a certain index x_j , the greater the distance between the index value X_{ij} , the greater the role of the index in the comprehensive evaluation. In information theory, information entropy $e_i = -k \sum_{j=1}^m P_{ij} \ln p_{ij}$, represents the orderliness of a system. The higher the order of the system, the greater the information entropy.

On the contrary, the higher the degree of disorder in a system, the more important information entropy is. Therefore, according to the difference between the index values, the information entropy tool can be used to calculate the weight of each index.

3.3.2.2 The principal component analysis

Principal component analysis attempts to recombine many original indicators with certain correlations into a new set of independent comprehensive indicators instead of the original ones. At the same time, according to actual needs, less sum can be extracted to reflect the information of the original variables as much as possible. In general, mathematical processing is to turn the original P indexes into linear combinations as a new comprehensive index. The most classic method is to use the variance of F_1 (the first selected linear combination, that is, the first comprehensive index). The larger the variance $Var(F_1)$, the more information F_1 contains. Therefore, F_1 selected in all linear combinations should have the largest variance, so F_1 is called the first principal component.

If the first principal component is not sufficient to represent the information of the original P index, consider selecting F_2 to select the second linear combination. In order to effectively reflect the original information, the existing information in F_1 does not need to appear again in F_2 . In mathematical language, $Cov(F_1, F_2) = 0$, then F_2 is called the second principal component, then the third, the fourth, ..., and P principal components can be constructed.

3.3.2.3 The CRITIC method

The objective weight of each evaluation index is determined by a combination of variability and conflict within the index. The variability within the evaluation index expressed in the form of a standard deviation, indicates the numerical difference between the evaluation objects of the same index. The larger the standard deviation, the greater the difference in values between objects. The conflict within the index can be expressed as $R_j = \sum_{i=1}^n (1 - r_{ij})$. The conflict between indexes is based on the correlation between indexes, where r_{ij} is the correlation coefficient between evaluation index i and indicator j . For example, there is a strong positive correlation between the two indexes, indicating a low conflict between the two indexes.

C_j shows the information contained in the j -th evaluation index, shown as
$$C_j = \sigma_j \sum_{i=1}^n (1 - r_{ij}) = \sigma_j R_j, \quad j = 1, 2, \dots, n.$$

The larger C_j is, the more information contained in the j -th evaluation index, indicating that the more important the index.

Acknowledgement

Fund project: Key project of teaching reform in Chongqing. Project No.: 182086; Key project of teaching reform in Chongqing Vocational Institute of Engineering. Project No.: JG2017005.

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