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Study on the Construction of the Multi-Dimensional Evaluation System for Teaching Quality in Chinese Colleges and Universities under the Background of Emerging Engineering

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***Abstract*—The construction of emerging engineering is an important content for higher engineering education in China in the new era. The emerging engineering requires the renewal of the ideas and model of talents cultivation. In view of this, establishing a suitable multi-dimensional evaluation system for teaching quality in Chinese colleges and universities is one of the important works under the background of emerging engineering. In the study, the matters needing attention in the construction of the multi-dimensional evaluation system for teaching quality (MESEQ) were analyzed. Then, MESEQ was established, which consisted of 7 primary indexes and 33 secondary indexes. At last, the rationality and the considerations of the application of MESEQ were analyzed. In general, this study constructed an effective MESEQ under the background of emerging engineering. The MESEQ established in this study can provide a guarantee for the training of high-quality and high-level engineering talents in the new period.**

Keywords—emerging engineering; teaching quality; multi-dimensional; evaluation system

I. INTRODUCTION

At present, the fourth industrial revolution is rapidly advancing. Confronting with the new challenges and opportunities brought by the fourth industrial revolution, it is necessary for Chinese colleges and universities to carry out the emerging engineering construction [1]. Since 2017, the Ministry of Education of the People's Republic of China has vigorously promoted the construction of emerging engineering. With a series of preliminary explorations (e.g., "the Fudan Consensus", "the Tianda Action" and "the Beijing Guide"), the connotations, guides and routes of the emerging engineering have been gradually formed. Compared with the traditional engineering, the emerging engineering pays more attention to the interdisciplinarity, comprehensiveness and practicability of disciplines, as well as the integration of new technology and traditional industrial technology [1]. That is to say, the emerging engineering requires the cultivation of new talents with excellent practical ability, innovation ability and international competitiveness. Therefore, the emerging engineering has put forward higher requirements on the quality of talent cultivation in colleges and universities [2]. At present, how to cultivate high-quality compound engineering talents under the background of emerging engineering has attracted extensive attention in China.

The teaching quality is an important guarantee for talent cultivation. To guarantee the teaching quality, the construction of the evaluation system for teaching quality is essential [3]. In view of the variation of talent cultivation requirements under the background of emerging engineering [4], it is imperative to establish a multi-dimensional evaluation system for teaching quality. That is to say, the multi-dimensional concept should be observed for the construction of an evaluation system for teaching quality under the background of emerging engineering. Through the application of a multi-dimensional evaluation system for teaching quality, the comprehensive evaluation results of teaching quality can be scientifically acquired, which

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in turn effectively guarantees the promotion of emerging engineering construction.

In this study, the matters needing attention in the construction of the multi-dimensional evaluation system for teaching quality under the background of emerging engineering were analyzed. After that, MESEQ consisting of 7 primary indexes and 33 secondary indexes was established. At last, the rationality of MESEQ was discussed, and the considerations of application for MESEQ were analyzed. The MESEQ constructed in this study can provide an effective guarantee for the teaching quality and talent cultivation quality under the background of emerging engineering.

II. Matters Needing Attention for the Construction of MESEQ

A. Normativity

The Ministry of Education of China has issued a series of guiding principles and action guidelines for the construction of emerging engineering. In view of these guiding documents, the construction of MESEQ should follow the corresponding requirements of these documents to meet the normativity.

B. Applicability

MESEQ should be applicable. For the construction of emerging engineering, the interdisciplinarity, practicability and comprehensiveness of disciplines were emphasized. Thus, in the construction process of MESEQ, the universality, representativeness and effectiveness of indexes should be considered, so as to effectively ensure the applicability of MESEQ.

C. Consistency

Compared with traditional engineering, emerging engineering has higher requirements on the quality of talent cultivation. However, there are still some consistent requirements for talent cultivation in the two types of engineering education. For example, no matter what kind of engineering education, it always requires cultivating students with morality, ideals and social responsibility. As for the consistent requirements mentioned above, it could be inherited or referred to while constructing MESEQ.

D. Integrality

The emerging engineering requires that cultivation talent has an excellent comprehensive quality. Therefore, the MESEQ should be a systematic, comprehensive, and wide-ranging system. Namely, the indexes of MESEQ should be comprehensive and rich, and the modules of MESEQ should be functional and hierarchical.

III. Construction and Analysis of MESEQ

A. Selection of Indexes of MESEQ

For the construction of MESEQ, 7 primary indexes and 33 secondary indexes were selected. These indexes are elaborated as follows.

1) Index of social needs and construction of majors

Developing the construction of majors of emerging engineering and training engineering talents for the new economy are two of the several topics of the emerging engineering project guide, indicating that social needs and major construction are the important evaluation contents of engineering students' cultivation quality under the background of emerging engineering. In consequence, MESEQ should include the index of the social needs and construction of majors (PI 1). For the social needs, 3 secondary indexes should be involved, i.e., the social reputation of majors (SI 1), the employment situation of majors (SI 2), and the position of majors (SI 3). For the construction of majors, 4 secondary indexes should be considered, i.e., the construction planning of majors (SI 4), the talent cultivation program (SI 5), the construction situation of the professional team (SI 6), the construction funds and achievements of majors (SI 7).

2) Index of course construction

The course construction is the key to the talent cultivation quality and plays an important role in the quality of higher education in China. Therefore, it is necessary to involve the indexes of the course construction (PI 2) (i.e., the principal and speaker of course (SI 8), the reform of the teaching content and the course system (SI 9), the syllabus (SI 10), the textbook and related materials (SI 11), the construction of multimedia teaching (SI 12)) for the establishment of MESEQ.

3) Index of basic qualities of the teacher

The cultivation of high-quality talents is affected by the basic quality of the teachers [5, 6]. The moral character and educational level of the teachers affect the abilities of the students in various aspects. Thus, the ethics and teaching ability of the teachers should be involved in the multi-dimensional evaluation system. Furthermore, the strong engineering background and engineering practice ability of the teachers are required in the construction of emerging engineering, which requires that the teachers have the abilities of research, engineering practice and student guidance. Overall, 5 secondary indexes (i.e., the ethics of the teachers (SI 13), the teaching ability of the teachers (SI 14), the ability of research (SI 15), the ability of engineering practice (SI 16), and the guidance ability for student (SI 17)) should be included in the index of basic qualities of the teachers (PI 3) for the establishment of MESEQ.

4) Index of course teaching conditions and their utilization

The course teaching conditions and their utilization usually affect the quality of talent cultivation. Therefore, the course teaching conditions and their utilization are always used as an effective index for the evaluation of teaching quality. Considering the consistency for the construction of MESEQ, the index of course teaching conditions and their utilization (PI 4) was selected in this study. For the teaching conditions, the teaching facilities (e.g., the construction of campus infrastructure (SI 18), the equipment used for teaching and scientific research (SI 19), the campus network resources (SI 20)) are effective indexes. Moreover, the students' research and training program (SRTP) is an important measure for Chinese colleges and universities to promote the cultivation of high-quality talents, which can reflect the utilization of teaching

conditions. Thus, the index of course teaching conditions and their utilization should include the following 4 secondary indexes, i.e., SI 18, SI 19, SI 20, and the situation of SRTP (SI 21).

5) Index of the effect of theory teaching

The teaching quality is directly affected by the effect of theory teaching. Hence, the effect of theory teaching should be involved in MESEQ. The two secondary indexes, the pre-class preparation of theory teaching (SI 22), and the methods and means of theory teaching (SI 23) are usually used to guarantee the effect of theory teaching. In addition, the other two secondary indexes, the contents of theory teaching and the learning state of students (SI 24), and the management of the classroom and the attitude of students (SI 25) also can reflect the effect of theory teaching. In summary, the above four secondary indexes should be included in the effect of theory teaching (PI 5).

6) Index of implementation and effect of practice teaching

Practice teaching is an important process in both traditional engineering and new engineering. In the "Research and practice projects of new engineering disciplines" published by the Ministry of Education of China in 2017, the practice teaching has received the focus. Considering the normativity for the construction of MESEQ, it is necessary to involve the indexes of implementation and effect of practice teaching (PI 6). Five secondary indexes (i.e., the arrangement of practice teaching (SI 26), the basic conditions of practice teaching (SI 27), the methods and requirements of practice teaching (SI 28), the management of practice teaching and the attitude of students (SI 29), and the academic and comprehensive quality performance of students (SI 30)) were selected in the index of implementation and effect of practice teaching.

7) Index of teaching quality management

The standardized teaching quality management can effectively guarantee teaching quality. Therefore, it is necessary to include the index of teaching quality management (PI 7) for the establishment of MESEQ. To implement the teaching quality management with high quality, the index of teaching quality management should be composed of at least the following three secondary indexes: the management system of teaching quality (SI 31), the teaching quality management organization and implementation (SI 32), and the teaching quality information utilization (SI 33).

B. MESEQ established in this study

Based on the above analysis, a multi-dimensional evaluation system for teaching quality in colleges and universities under the background of emerging engineering was established. The established MESEQ included 7 primary indexes and 33 secondary indexes. The specific MESEQ is shown in Fig. 1.

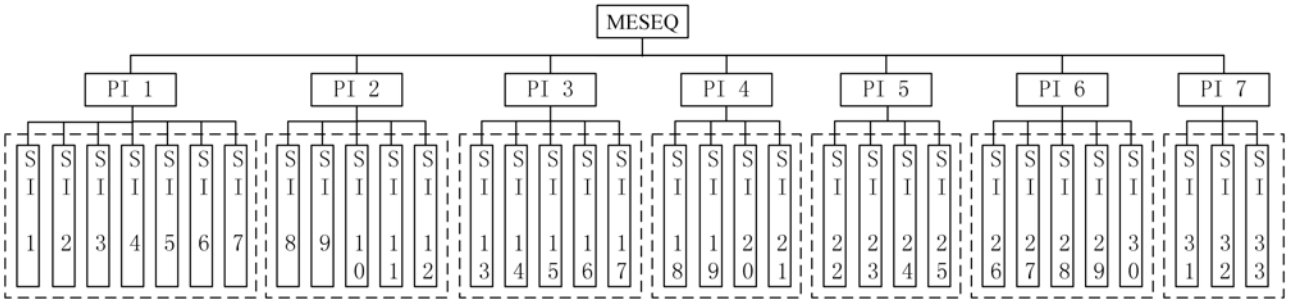

Fig. 1. The multi-dimensional evaluation system for teaching quality in Chinese colleges and universities under the background of emerging engineering

C. Rationality and considerations of application of MESEQ

For the construction of emerging engineering, colleges and universities should pay attention to the construction of high-quality teachers team, the formation of the high-level talent training system, the establishment of the cross-disciplinary groups and scientific teams, the reinforcement of the collaborative innovation among disciplines, and the cultivation of talents with all-round development (e.g., morality, intelligence, physical fitness and beauty). As a whole, the MESEQ constructed in this study confirmed the above contents from all levels. Thus, MESEQ is suitable for the evaluation of teaching quality in colleges and universities under the background of emerging engineering.

For the application of MESEQ, explaining the secondary index should be carried out firstly, which can help the evaluation executor to understand the connotation of the index. Then, the weights of the primary and secondary index should be determined, which can be determined by the analytic hierarchy process. For the evaluation result of MESEQ, it can be acquired by adding the product of each index score and the corresponding index weight. After obtaining the evaluation result, it should be analyzed to find out the indexes with low scores so as to find out the problems of teaching quality. At last, for these problems, the manager of teaching quality can perform the corresponding rectification measures in combination with the actual situation to effectively improve the teaching quality.

IV. CONCLUSION

In this study, MESEQ was established under the background of emerging engineering. The MESEQ involved 7 primary indexes and 33 secondary indexes. The analytic hierarchy process can be used as the optional method to acquire the weights of indexes. For the evaluation result of MESEQ, it can be acquired by adding the product of each index score and the corresponding index weight. The MESEQ established in

this study could provide an effective guarantee for teaching quality under the background of emerging engineering.

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