Optimizing Course System of Information Engineering—Under the Background of Establishing the Emerging Engineering

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Abstract. Under the background of establishing the Emerging Engineering, combined with the requirements of engineering education certification system for the training of information engineering professionals, the optimization scheme of curriculum system is put forward. On the basis of introducing the background of curriculum system construction, this paper elaborates on the optimization ideas, curriculum system structure design and evaluation criteria. Focusing on the optimization of the curriculum system, the teaching team is formed with the curriculum group as the teaching unit to form a systematic, coordinated and adaptable teaching-group mode.

Introduction

In order to achieve the general goal of the Chinese dream, the state proposed the overall layout of the "five in one", the "four comprehensive" strategic layout, the new development concept of "innovation, coordination, green, openness and sharing", and the major strategies of innovation driven by development, "one belt and one road", "made in China 2025", and "Internet +". Since the Ministry of Education launched the pilot project of professional certification of engineering education in May 2006, new requirements have been put forward for the construction of Engineering Specialty in line with the strategic development of the country. Based on the needs of the above-mentioned major national strategies, establishing the emerging engineering should take the initiative to lay out, set up, construct and develop related new disciplines and specialties. The goal is to train outstanding engineering talents of all levels and types[1-5]. Under the new situation, it is necessary to optimize and adjust the original engineering specialty. This paper studies the optimization methods of the curriculum system of information engineering specialty.

The curriculum system is an important part of the seven first-level indicators in the national professional certification standard of engineering education (trial). The development of higher education requires the constant adjustment of discipline structure and curriculum setting, the update of knowledge structure and curriculum content, the expansion of knowledge in related fields, thereby meeting the demands for talent in line with the development of science, technology, economy and society, and constantly improving the quality of undergraduate talents in information engineering [1].

Focusing on the reform of the curriculum system of information engineering major, some scholars have made explorations and achieved certain research results. For example, Han Peng et al. [6] took the undergraduate teaching evaluation work as an example and sorted out the training process and quality assurance work in the undergraduate talent training of electronic information engineering major of Northeastern University at Qinhuangdao. Ma Yan e et al. [7] combined with the revision of the curriculum system in the training objectives made by independent colleges, optimized the credit hours of theoretical courses, increased the credit hours of experimental practice and practical training courses, and re-selected more suitable textbooks for application-oriented undergraduate colleges. Guan Lian et al. [8] discussed the school-enterprise cooperation model of ‘co-creation, symbiosis and win-win’ in the context of Emerging Engineering, the UBL talent cultivation model of school-enterprise collaborative education, and the design of practical curriculum system based on the integration of industry and education. Taking the practical training in primary school as an example,
they introduced the implementation and effect of the practical curriculum system. Gao Di et al. [9] analyzed the problems existing in traditional course teaching from the perspective of Emerging Engineering and proposed improvement methods.

Compared with traditional engineering, "Emerging Engineering" has two characteristics: firstly, it emphasizes the comprehensiveness, intersectionality and practicality of disciplines; secondly, it emphasizes the cultivation of Emerging Engineering talents with abilities to solve complex engineering problems and lifelong learning [10]. The cultivation of these abilities needs to run through the course teaching of students. Under the big environment, to explore ways for continuous improvement of education under the Emerging Engineering background must be on the agenda. This paper focuses on exploring the optimization of curriculum system in the educational reform of information engineering, and takes the optimization of curriculum group construction as the main object, so as to lay the foundation for the next step of promoting the alignment between professional courses and discipline curriculum and arranging thoughts in order.

Optimize Ideas of Curriculum System

In terms of the norms of overall curriculum system, ‘Washington’ certification standards shall be the criterion. We will organize and optimize the course system of information engineering major at three levels according to the hierarchical control method of ‘course system- course group- main course’. The basic idea is as follows: firstly, select a number of available alternative courses in the major of information engineering and related disciplines, reorganize the main courses through interdisciplinary and content reorganization. Secondly, merge them into a number of course groups according to the similarity of teaching content and function. Thirdly, design the overall course system according to the hierarchical control and three-level optimization principle. The curriculum system is a knowledge-technology system composed of many courses, and the Emerging Engineering education requires a better connection between the major and the industry. Therefore, expert consultation, graduate questionnaire survey, hierarchical analysis and comprehensive evaluation method are feasible methods for the development and optimization of this kind of system. Accordingly, we will issue our EE alliance enterprise and graduates with questionnaire, investigate the required professional courses in information engineering specialty and the importance of consulting, and then use the AHP method to determine the weight of each course so as to provide theoretical support for the optimization of curriculum system and distribution of school hours(this is the next step of work). In the current curriculum system of information engineering major, the integration degree of each course is relatively weak. Only a course group by signal processing is formed, which plays a very important role in professional education. But other courses fail to give full play to each other. For the setting of the course group in the future curriculum system, we have a preliminary idea-- plan to set up 8 course groups (as shown in Fig. 2), and integrate each basic professional course and compulsory professional course into a course group to form a team-style teaching form. We will take the curriculum group as the object to form a standardized curriculum system. The content and teaching method reform of each course will be consistent with the curriculum group.

Designing Course Curriculum Structure

Course Curriculum Structure

The curriculum system of information engineering major is a combination system of knowledge with specific function, structure and openness. The curriculum system is adjusted and revised every four years according to the training objectives and graduation requirements of the major, combined with the feedback from teachers, employers, industry and enterprise experts and students/graduates. The latest credit setting of this major in curriculum system is shown in Fig. 1.
The curriculum system in Figure 1 is divided into five pieces, it will not only contain professional basic course, professional theoretical courses, professional practice courses and humanities and natural science courses, which form a interrelated and unified whole, but also support the training target and graduation requirements, adapt to the demand of the social and economic development, reflect the present situation and development trend of science and technology, and conform to the education system and limits of school hours. At present, courses are included into 8 course groups, as shown in column 1 in Table 1, and the specific courses included in each course group are shown in column 2 in Table 1. Set up corresponding teaching teams according to the course groups, and form the unified system of the course groups coordinated and managed by the team leaders. This management mode is convenient for organizing the teaching discussion within the course group, coordinating and updating the teaching content, as well as facilitating the team communication among the course groups.

<table>
<thead>
<tr>
<th>Name of Curriculum Group</th>
<th>Courses Covered</th>
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<tbody>
<tr>
<td>Technology Group of Electronic Circuit</td>
<td>Circuit Analysis, Basic Practice of Electronic Technology, Digital System and Logic Design</td>
</tr>
<tr>
<td>Telecommunication System Group</td>
<td>Electromagnetic Field and Electromagnetic Wave, Communication Electronic Circuit, Communication Principle, Computer Communication and Network, Quantum Information and Communication</td>
</tr>
<tr>
<td>Technology Group of Sensing and Control</td>
<td>Automatic Control Principle, Sensing and Micro-sensing Basis, Wireless Sensor Network Technology</td>
</tr>
<tr>
<td>Program Design Group</td>
<td>Computer Information Technology (Office Application, Big Data Application, Computational Thinking), Program Design and Application (C, JAVA, PYTHON), Microprocessor and Microcomputer System, Embedded System</td>
</tr>
</tbody>
</table>

**Construction of Featured Courses**

In terms of specialized construction of professional courses, we will take the synthesis application curriculum as the main stem curriculum to carry on the pilot reform. Systematic subject research and practical experience are very important for students majoring in information engineering. In this aspect, we plan to start from two aspects. One is to reform and optimize the content and teaching methods of original application-oriented course. The second is to set open and comprehensive applied subjects, which will be issued from the first year of college to enable students to finish the subjects
independently in their spare time. Such a process puts forward higher requirements for students' self-learning ability and how to seek help to solve problems when they encounter difficulties. The corresponding assessment method of open curriculum is very important. We will report and track the assessment regularly to continuously care about and guide the progress of the project for students, and put forward different requirements according to different progress. The basic principle of open subject is to give full play to the creative ability of potential students on the basis of ensuring that every student can complete the basic standard requirements. Therefore, teachers of information engineering need to work together to design good topics, which need to be forward-looking, so that each class of students can complete the system design of a key technology with applied value in the industry when they graduate.

**Course System Evaluation**

In terms of the index system and evaluation model of curriculum system optimization, in order to achieve the optimization goal of curriculum system structure, we will establish a mathematical model of comprehensive evaluation, and make a scientific choice from the comparison of multiple alternatives. By integrating the opinions of relevant industry experts, combining the opinions of teachers and students majoring in information engineering, and considering multiple indicators as a whole, "questionnaire star" can be used as a questionnaire for mobile phone users, which is both convenient and fast. At present, the construction of the standardization and specialization of the curriculum system of information engineering major should focus on highlighting the goal, strengthening the foundation, optimizing the structure, enhancing the application, highlighting the characteristics and conforming to the development. N multiple evaluation criteria were set for each type of target to form a multi-level and multi-objective index system. Due to the unequal weights among the indicators and the different professional courses and course groups involved, it is obviously difficult to determine the weights and quantities. Therefore, the analytic hierarchy process (ahp) established by T. Saaty [11,12] and the fuzzy comprehensive evaluation method established by L. Zadeh [13] are proposed for analysis and calculation. The whole evaluation and decision-making process is carried out in four steps: i. evaluation of the satisfaction degree of a single factor. ii. comprehensive evaluation of the index system. iii. comprehensive evaluation of the curriculum system is carried out, that is, the conclusion of the evaluation of various factors is synthesized and the final conclusion is drawn. iv. evaluation of featured courses was carried out, and scores were given by substituting multiple indexes with different weights to express featured courses, and the scores were obtained by calculation model.

**Conclusion**

To cultivate qualified professionals of international information engineering, and conform to the accreditation standards of engineering education (2012 edition), the course system in 2017 training scheme has been optimized, the training objectives of information engineering has been established, the basic requirement for the graduates to acquire knowledge and ability has been put forward so as to meet the requirements of the certification standard through the adjustment of the curriculum system. According to the certification standards, the curriculum system needs to be constantly improved. Therefore, problems should be constantly found and regular optimization of curriculum system should be made during the implementation of the training program.

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References


