Research on the Reform Path of Engineering Education Curriculum System in Local Universities Under the New Engineering Background

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Abstract. The traditional curriculum setting mode is still the bottleneck restricting the reform of engineering education in local universities. The curriculum setting framework of the "discipline" system occupies a dominant position, resulting in the inability to connect the training objective, curriculum objective and curriculum system. Under the new engineering background, the reform of engineering education in local universities is promoted. Curriculum system reform is the basis of action plan. According to the principle of order, completeness, appropriateness and testability, handling the relationship between the theoretical courses and practical courses, branch courses and comprehensive courses, compulsory courses and elective courses, explicit courses and implicit courses, innovation education courses and entrepreneurship education courses, that is conducive to promoting the transformation and development of local undergraduate universities.

Engineering education requires courses, and the mission of course is to educate students. The Accreditation Board for Engineering and Technology has proposed talent training standards for 11 aspects of undergraduate engineering education[1]. The European Federation of National Engineering Associations has proposed 12 standards for engineer' competence[2]. There are 7 competency standards in the professional certification standards of engineering education formulated by Japan Accreditation Board for Engineering Education[3]. The certification standards of China Engineering Education Accreditation Association are divided into two parts: general standards and professional supplementary standards. The general standard sets 3 training objective and 12 graduation requirements to support the achievement of training objective[4]. The training objectives of the world's undergraduate engineering education are gradually becoming standardized and equivalent, but the realization of the training objective needs to be supported by the corresponding curriculum system. In other words, the starting point and the foothold of undergraduate engineering education reform is the curriculum system reform.

Theoretically, the course objectives play an intermediary role in connecting the training objectives and the curriculum system. Generally speaking, in most local universities training objectives must either imitate key undergraduate or imitate the foundation of the
professional level perform a simple "upgrade". As a result of the "displacement" of the training objective, the curriculum objectives are not constructed in strict accordance with the requirements of the training standards on knowledge, ability and quality, and the requirements between the curriculum system and the local economic and social development are not fully matched. Although student has completed all courses, get the regulation of credit, but have not formed a more comprehensive view of knowledge and more realistic view of life. Therefore, local universities must determine the principles of curriculum system, optimize the curriculum structure.

1 The dilemma of the reform of engineering education curriculum system in local universities

1.1 The disconnection between theoretical courses and practical courses

The theoretical course focus on the theoretical knowledge of engineering specialty, emphasizing system and completeness. Practical courses focus on training the ability of engineers, and focus on applicability and practicality. Engineering education carries the two genes of "engineering" and "education" from its origin, and tries to balance the pendulum of "practice" and "theory" in its development. In the engineering education of local universities, they show the dilemma of attachment, separation and connection in the course status and implementation. First, from the course design and arrangement, basically theory first, practice after class, but there is no perceptual knowledge when learning theoretical courses, and the theoretical courses knowledge is often not used class when learning practical courses, so it is difficult to put theoretical knowledge into practical ability; Second, from the perspective of course content selection, most of stakeholders such as industry and enterprises only play a supporting role. To some extent, the curriculum system deviates from the actual needs of the industry and the development of enterprises, and does not adapt to the adjustment and development of local industrial structure.

1.2 The piece between branch courses and comprehensive courses

The branch course focuses on the vertical, logical and independent nature of engineering knowledge. The comprehensive course focuses on the laterality, richness and connection of engineering knowledge. Since the 1860s, the American engineering education paradigm has experienced a transition from the original "traditional technology paradigm"to a "research-based scientific paradigm", and the "return to practice". This modern concept of training engineers in "return to engineering" requires not only the ability to involve technical factors (hard ability), but also the ability to solve non-technical factors (soft ability). The training mode of engineering education talents in local universities in China is dominated by "specialty education", with the feature of "de-engineering", and engineering talents tend to be "roughening". At present, branch courses still occupy a dominant position, with a small proportion of interdisciplinary and comprehensive courses. Most of the comprehensive courses are also "appearing in harmony", and interdisciplinary courses are splicing in a "low degree". Therefore, subject to the rigid view of disciplinary culture and narrow interests of the professional system, it may lead to the trend of professionalism and professionalism, resulting in the composite talents acquired incomplete.
1.3 The imbalance between compulsory courses and elective courses

The general standard of CEEAA certification standards has specific provisions on the proportion of course setting, but the proportion of compulsory courses and elective courses is not clear in the local undergraduate engineering education, and the credit arrangement is not flexible. First, in the aspect of public elective courses, the proportion of elective courses is relatively low, showing the phenomenon of miscellaneous and chaotic, and there are few general education courses to cultivate the quality of technical engineers in various aspects. Second, in terms of professional elective courses, more restricted elective courses than non-restricted elective courses, so that students can choose a narrow range. Restrictive elective courses are also lacking in applicability, professional core knowledge and career development direction function is not strong. For example, in the talent cultivation program of chemical engineering and technology major of H college, 220 credits of compulsory courses, and 15 credits of elective courses only account for 6.81% of the total credits[6].

| Module type                        | Credit | Proportion (%) | Practical Credits | Practical Credit Proportion (%) | Compulsory Credits | Elective Credits | Proportion of Elective Credits (%) |
|------------------------------------|--------|----------------|------------------|-------------------------------|-------------------|-----------------|-----------------------------------|
| Mathematics and Natural Sciences   | 40.5   | 17.23          | 9.5              | 4.04                          | 40.5              | 0               | 0.00                              |
| Engineering Foundation             | 25.5   | 10.85          | 10.0             | 4.26                          | 22.5              | 3               | 1.28                              |
| Professional Foundation            | 53.5   | 22.77          | 14.0             | 5.96                          | 51.5              | 3               | 1.28                              |
| Professional Engineering Practice and Graduation Thesis | 4.0    | 1.70           | 0.0              | 0.00                          | 0.0               | 4               | 1.70                              |
| General Education of Humanities and Social Sciences | 66.5   | 28.30          | 66.5             | 28.30                         | 65.5              | 0               | 0.00                              |
| Total                              | 235    | 100.00         | 107              | 45.53                         | 220               | 15              | 6.38                              |

1.4 The separation between explicit course and implicit course

Explicit course is a direct and explicit that is incorporated into the talent cultivation program in the educational context and focuses on knowledge and skills. Implicit course is an indirect and implicit that is not included in the talent training program in the educational context and focuses on the content learning of emotion and will. The traditional engineering education in local universities emphasizes the dominant course over the implicit course, the infiltration and fusion of the two are even rare. First, the traditional engineering education believes that the explicit courses have a decisive influence on the acquisition of engineering knowledge and the cultivation of engineering ability, while the implicit courses do not attach importance to the cultivation of students' engineering ethics, science and technology ethics and professional ethics; Secondly, the development and implementation of implicit course in traditional engineering education are concentrated in the macroscopic field. Local universities ignore the institutional, cultural and other areas of the micro, although some universities of engineering education implementation of innovation and entrepreneurship
practice for credit in the form of a play to the effect of implicit course, implicit course orientation is limited to the extracurricular activity level.

1.5 The vacancy between innovative education courses and entrepreneurship education courses

The course of innovation education focuses on training engineers' innovative spirit, innovative thinking and innovative ability, enhancing their quality of seeking for new and changing, and creatively solving specific problems. Entrepreneurship education courses focus on training engineers' entrepreneurial awareness, entrepreneurial quality and entrepreneurial ability, improving entrepreneurial action skills, and rationally planning career development paths. According to the employment report of Chinese university students in 2016, the proportion of vocational college graduates who start their own businesses (3.9%) is higher than that of graduates (2.1%). First, "Course Quantity Only" believes that engineering education should be taught in accordance with national policies for the whole and in different categories, and should focus on the theoretical knowledge teaching. Second, "Project Quantity Only" holds that the engineering education should combine the innovation and entrepreneurship training program for university students and the activities oriented to the engineering discipline competition, and should focus on the practical operation of innovation and entrepreneurship. But in the local universities the content of cohesion is not enough, and project homogeneity serious, leading to the innovation entrepreneurship education and engineering education is not tight and effective.

2 Construction principles of engineering education curriculum system in local universities

2.1 The principle of sequentiality

The thinking shift of the reform of engineering education curriculum in local universities should not only focus on the perspective of engineering, but also have another kind of structural ability—the ability of order change. "Order" is a way to arrange the elements of things in a regular way. Order change "in the curriculum system is mainly not the continuous change in the sense of time, but the correlation change in the sense of logic-relation"[7]. In local universities should not only focus on the logical organization of knowledge meaning, but also consider the law of psychological meaning of students' background. According to the longitudinal organization sequence of the curriculum structure, the time series and the pace of the curriculum structure are defined.

2.2 The principle of Integrity

Due to the versatility of engineering social background, the complexity of engineering problem solving, the process of life cycle of engineering products, and the systematic nature of engineering activities, etc. Modern engineering education curriculum needs to be subject intersected fragmentation knowledge to be integrated, forming courses system of "overall optimization law", getting rid of the bound, the cocoon of reductionism thinking training "perfect" image of the engineer[8]. Therefore, "integrity is the key to the effectiveness and efficiency of curriculum delivery."[9] The course structure of local universities should be organized in a horizontal sequence, to make clear that the overall program of the course is a systematic whole.
2.3 The principle of suitability

The society's demand for the reform of engineering education curriculum is usually represented by engineering education stakeholders. The curriculum reform should serve the stakeholders, and the stakeholders can also react to the curriculum reform. Due to the difference in the division of labor among different professional engineers, engineering education cannot always go ahead of the demand for diverse talents due to its own hysteresis. Therefore the local universities engineering education should establish course quality guarantee mechanism that based on society and the continuous improvement of self feedback, appropriately solve the dilemma of breadth and depth of knowledge, overall choice and individual choice, local "the international vision and local vision.

2.4 The principle of testability

The Outcome-Based Education is an important basis for the professional certification standard of engineering education. That is mainly reflected in three levels: institutions (characteristics of graduates), majors and courses. The curriculum is the main aspect. As a curricular pre-management model, the establishment of learning outcomes is often based on Bloom's Taxonomy of cognitive objectives. The curriculum of the local universities is and measurable. According to the requirements of graduation, reverse design training objectives; the cultivation standard and curriculum system are developed, and the matrix of "competency standard-curriculum knowledge" is constructed. Then, the teaching plan should be implemented positively, and the learning results should be evaluated and formed a continuous improvement education model. This model emphasizes the consistency of outcome-based, teaching and learning activities, and examination evaluation.

3 Reform path of engineering education curriculum system in local universities

3.1 From disconnection to integration: reconstructing the relationship between theoretical courses and practical courses

So in local universities should integrate the achievements of "science first" with "serving the engineering practice", and basically close the gap between "engineering education narrow in technology" and "engineering education narrow in technology". First, strengthen practical courses and emphasize comprehensive quality training. Local universities should increase the teaching hours of engineering practice to ensure that the ratio of theoretical teaching content to practical teaching content is about 3:1. And centering on the vertical and horizontal organization sequence of engineering knowledge, integrates theoretical courses and practical courses. Second, to meet the needs of the society, the emphasis on the development of characteristic model. Mr. Mao Yisheng once put forward the model of "learning from practice". Local universities should align the adjustment of regional industrial structure, strengthen the collaborative training between schools, and enterprises, and promote the reform of practical teaching.

3.2 From piece to integration: reconstructing the relationship between branch courses and comprehensive courses

Modern engineering education is characterized by systematization, complexity, diversification, globalization and sustainable development. "Life scenarios don't tell us
which aspects are sociological, which aspects are historical, which aspects are economic, which aspects are political. Domenico Grasso put forward the "holistic engineering view" in response to the demand that engineering has no boundary. "In short, for engineering, it is a more interdisciplinary and system-wide approach. In a rapidly changing world, emphasizing the context in which problems are formed, leading team-centric engineering projects, the ability to communicate across disciplines, and the desire for lifelong learning. Based on the concept of "society-people-environment-technology", the engineering education of local universities should build a cross-disciplinary and cross-specialty collaborative education mechanism. It is implemented in the form of PjBL, CDIO, Co-op and other courses with different degrees of integration in the common field to solve practical engineering problems.

3.3 From imbalance to complementarity: reconstructing the relationship between compulsory courses and elective courses

It is a trend that the proportion of elective courses is greater than that of compulsory courses in engineering education. First, increase the number of elective courses, increase the proportion of elective courses. As different "commodity and service" packages -- course combinations -- suppliers, local universities gradually evolve into "course consumers". In theory, the more and more engineering courses they offer, the more diverse the development of university students will be, and the more likely the engineers will be to adapt to the needs of economic and social development. Second, strengthen the management of elective courses and improve the expected efficacy of courses. Local universities should reorganize elective courses according to the course group modules. Course management is achieved in order to serve the objective, through the curriculum management (executive) and the practitioners on the concept and action between (faculty) from reality to cooperation, to avoid the "smorgasbord" curriculum overload phenomenon.

3.4 From separation to penetration: reconstructing the relationship between explicit courses and implicit courses

It can be said that the explicit courses are the fertile soil of the engineer, and the implicit courses are the rain and sunshine of the engineer, both of which are immersed in each other to maintain the tension in function. First, reform and enrich the explicit curriculum. Local universities should change from the concept of "great unity" to the concept of unity and diversity. Under certain conditions and meanings, it promotes the transformation of explicit courses and implicit courses, and expands the scope and content of engineering education curriculum. Second, research and emphasis on implicit courses. Local universities should combine engineering education to make implicit courses construction plan, construction of implicit courses classification framework, considering the material-space, organization-system and culture-psychology class 3 kinds of the influence of different levels of implicit courses for students (Liu Genping, Huang Songhe: the implicit courses theory). Therefore, osmotic education is one of the important ways to combine explicit and implicit courses. Shantou university in the EIP-CDIO engineering education mode that build explicit courses and implicit courses interaction model of engineering education.

3.5 From vacancy to replacement: reconstructing the relationship between innovation education courses and entrepreneurship education courses

Innovation and entrepreneurship education focuses on "education". Local undergraduate should integrate innovation and entrepreneurship education into the general education and
professional education, and train innovative technical engineers. First, the scientific establishment of innovation and entrepreneurship education courses. According to the objective, local universities should set up curriculum contents by building a group of specialized courses of innovation and entrepreneurship education that are progressive, organic and consistent throughout their careers. Second, strengthen innovation and entrepreneurship projects to human nature. Local universities should effectively link innovation and entrepreneurship projects with engineering practice teaching, explore projects for engineering undergraduates. Third, we should pay attention to the organic integration of innovation and entrepreneurship courses and engineering education. At present, the integration of innovation and entrepreneurship education and professional education mainly consists of three modes: cluster, dispersed and mixed. The engineering education of local universities can draw lessons from the hybrid model. For example, The Franklin Orlin Institute propose "orlin triangle" of engineering education.

4 The conclusion

So the reform of engineering education curriculum system, as a "map" of engineer training, will become an extremely important part. On the one hand, our country is in the manufacturing power towards a manufacturing powerhouse, made by engineering education powers two transition towards engineering education powers, an urgent need to promote the supply side of the propulsion engineer training structural reforms. On the other hand, the local universities to "deepen teaching fusion, university-enterprise cooperation, cooperative education, promote the upgrade to traditional engineering course", called for the traditional subject oriented curriculum system for architecture. Therefore, local universities should combine the objectives and tasks of transformation and development, break out of the "discipline" system of engineering education curriculum framework, and create the Chinese Model of Engineering Education in local universities in the new era.

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