

Reform of Practical Teaching of Engineering Majors in Higher Education

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Abstract: Practical teaching is an important part of cultivating application-oriented talents and implementing comprehensive quality education. However, the current practical teaching has problems such as emphasizing theory over practice, single teaching mode, lack of supporting expenses for teachers, and irregular and unsound mechanism and system. To promote the reform of practical teaching of engineering majors in local application-oriented colleges and universities, it is necessary to integrate a diversified practical teaching system. More importantly, it is essential to strengthen the on-campus organization of schools, colleges and departments, and the off-campus functions of practice bases and in-post enterprises. With these efforts, an organizational structure with full coverage of supervision and guaranteed quality improvement will be formed. The practice teaching base will be advanced in an all-round way by means of improving the practice base and promoting learning through competitions. In this way, various management systems can be established for reform so as to build a school-enterprise deep integration mechanism. It is necessary to take process assessment and comprehensive assessment as the main assessment approaches of practical teaching and improve the feedback mechanism of quality from all parties of practical subjects. In the process of practical teaching of engineering majors, local application-oriented colleges and universities need to further clarify their orientation, refine the characteristics of engineering majors and promote students' comprehensive abilities such as theoretical learning and practical operation. In turn, a set of practical teaching operation mechanism will be provided to improve practical teaching to cultivate application-oriented professionals.

1. Introduction

Practical teaching is an important part of cultivating the application-oriented talents urgently needed by the country and implementing education for all-round development. It is the continuation, verification, supplement and expansion of theoretical teaching, which can effectively improve the

practical operation ability of engineering majors. As such, its status in engineering majors cannot be ignored[1]. The quality of practical teaching is the key to training qualified engineers. To deliver high-caliber operational and practical engineers to the society, local application-oriented colleges and universities must change their talent cultivation mode, i.e., to strengthen the comprehensive quality and practical ability of students. This is the right direction of professional teaching reform for application-oriented engineering majors[2].

2. Current Problems in Practical Teaching

2.1. Disconnect between Theory and Practice is Widespread

Practical teaching is quite flexible. The practical teaching in engineering not only includes regular course experiments, but also requires students to go to off-campus internship sites built in cooperation with schools[3]. It is because of the wide scope of practical teaching that there are often a series of thorny problems such as complicated practical teaching sites, difficulty in organization, and lack of double qualified teachers with practical instruction background. Given there are not enough professional evaluation standards in the process of practical teaching guidance, engineering practice instructors, generally speaking, lack a unified evaluation standard[4]. Some units are reluctant to have students involved in specific engineering affairs due to safety factors and the trade-off of economic interests, resulting in the lack of professional practice opportunities for students. In addition, the practical guidance of on-campus instructors is trivial, such as the management of practical sites, the storage and improvement of instruments, and the safety management of students' training outside. Some tutors in schools do not pay enough attention to practical teaching given cumbersome instructional procedures, resulting in the phenomenon that teaching becomes nominal, and classroom learning is seriously derailed from extracurricular practice[5].

2.2. Lack of Supporting Guarantees for Practical Teaching Instructors and Expenses

The practical ability of students indirectly feeds back the quality of practical teaching, and to a certain extent, which is also related to the strength of teachers' leading teaching. In view of the fact that most college teachers lack practical experience, they are unable to impart student the skills, experience, professional ethics, and true insight needed in practice, which affects the effectiveness of practice teaching to some extent[6]. Many engineering application-oriented colleges and universities have implemented the double tutorial system and hired part-time practice instructors from off-campus practice units. However, due to the inadequate support of practice funds in colleges and universities, the compensation of off-campus practice instructors is very meager. Such disproportionate input and return has led some practice instructors to lose their enthusiasm for work. Some off-campus practice instructors only give one or two lectures. This kind of greatly reduced practical teaching effect is far from reaching the intended practical teaching objectives in the talent training program[7]. As we all know, engineering practice teaching sites are quite demanding, with large investment in instruments and related materials. Moreover, in the process of practice, the post-maintenance cost of the site and equipment is also very high. But, unfortunately, the income of engineering application-oriented colleges and universities, especially some independent colleges and universities, is in a single form, relying mainly on tuition fees paid by students and limited financial allocations. Consequently, insufficient expenses make it impossible to invest more in practical teaching sites and equipment, which, in turn, affects the effect of practical teaching[8].

2.3. Irregular and Unsound Mechanism and System of Practical Teaching

2.3.1. Inadequate Implementation of Practical Syllabus and Content

The syllabus is the programmatic document for teaching a course, which is the theoretical standard and guideline for the training program of engineering majors. The syllabus defines the basic contents and the nature of teaching. Nevertheless, in the practical teaching of engineering, some instructors as well as students still adhere to the traditional mentality of emphasizing theory over practice[9]. As a result, the practical teaching tasks formulated in the syllabus cannot be carried out effectively, resulting in the failure in completing the practical teaching objectives efficiently. In this context, the objectives of practical teaching in engineering are rather arbitrary, without any breadth or depth of teaching contents. Some schools even do not arrange students to have multi-faceted internship according to the practical teaching contents drawn up in the syllabus. It is precisely because of the above phenomenon that the goals and tasks of engineering practice teaching cannot be realized as scheduled according to the plan formulated in the syllabus, resulting in poor practice teaching effect[10].

2.3.2. Incomplete and Subjective Evaluation of Practical Teaching

At the end of practice teaching, most institutions evaluate students' practice in the form of conventional submission of practice summary reports and on-site practice debriefing. This practice teaching evaluation method which only focuses on the results but ignores the process is not scientific enough[11]. Educational evaluation is divided into process evaluation and result evaluation, but the conventional evaluation methods do not combine these two kinds of evaluation into one. Specifically, it does not consider the students' ideological trends, daily performance, difficulties encountered in the process of practice, solutions to problems and other process materials in the process of practical learning[12]. The evaluation of some off-campus practice units is not included in the evaluation of students' practical learning, indicating that there is no rigorous evaluation mechanism for the implementation of practical teaching syllabus. The current single evaluation method of practical teaching in engineering has no comprehensive evaluation content or multiple evaluation subjects. The result is that the evaluation mechanism of practical teaching is not perfect, and the evaluation is subjective, which does not truly reflect the students' performance in the process of practice and the practice achievements obtained. The way of focusing only on the result-based evaluation while neglecting the process-based evaluation makes it difficult to have accurate judgment on students' comprehensive quality of emotional attitude, learning outlook, engineering thinking, and practical ability combined with theoretical learning in the practical learning process[13].

3. Countermeasures for Improving Practical Teaching Reform

3.1. Opening Practical and Training Platform to Promote Teaching through Competition

It is essential for colleges and universities to maximize the benefits of practical and training platform resources inside and outside the school. In addition, it is also necessary to create an integrated practical and training platform mechanism with on-campus practical and training base as the main base, and social practice base as the supplement[14]. On the one hand, in terms of the management of on-campus practical and training platform, it'd be better to have a flexible management method, expand the opening hours of the platform and enrich the practical contents. Students are encouraged, according to their interests, to choose practical and training platforms of different nature for experimental operations as well as skills training. On the other hand, as for the

management of off-campus practice bases, it is necessary to make reasonable off-campus training plans and strengthen the richness of practical training contents. From the perspective of financial support, the construction of high-quality training bases should be intensified to guarantee the actual effect of practical training for students[15].

Students will stimulate their intrinsic learning motivation, and then mobilize their learning initiative through participating in various engineering disciplines competitions, and innovation and entrepreneurship training programs. In the process of participation, students can stimulate their learning interest, develop design and innovation consciousness, improve their hands-on and teamwork ability, and then form a discrete creative thinking. The practical support platform provided for students is conducive to carrying out practical teaching, building practical teams and truly promoting teaching through competition.

3.2. Reforming the Traditional Experimental Teaching Mode and Optimizing the Practical Teaching System

3.2.1. Changing Ideas to Attach Importance to Practical Teaching

The contents of experimental teaching and theoretical teaching should be coordinated, that is, according to the syllabus of theoretical teaching, the corresponding experimental projects should be arranged, which will help students to further understand the theoretical knowledge. Students' instructors need to not only carry out theoretical teaching, but also undertake practical teaching tasks, thus helping them combine theory and practice in teaching. Teachers should implement the objectives and contents of practical teaching in the syllabus, seriously implement the assessment requirements of practical teaching, and make detailed and dynamic evaluation of students in all aspects of practical learning. On top of that, it is essential for teachers to strengthen the ideological education of students, improve their hands-on ability and cultivate their craftsmanship. The teaching administrators of the college should strengthen the management of daily affairs of practical teaching, so that practical teaching and theoretical teaching can be treated equally. Only in this way, under the innovative practical teaching mode, can we achieve the educational effect of one plus one more than two.

3.2.2. Building a Multi-Level Practical Teaching System

It is imperial to deepen the reform of the existing practical teaching content and improve the practical teaching system for a multi-level practical teaching system. The hands-on ability, innovation ability and comprehensive application ability of core engineering technology should be taken as the focus of practical teaching. Engineering professional disciplines should refine the characteristics of practical teaching. In other words, the internship training activities that are closely integrated with practice, various practical discipline competitions that students participate in and social practice projects that are closely related to practical teaching should be taken as important supporting points for practical teaching. It is necessary to strengthen the students' participation in operational experiments and practical training activities. Besides, it is essential to raise the requirements for students' course design and graduation design, and encourage them to actively participate in social practice experience as well as various subject competitions. In this way, the basic theoretical knowledge of engineering and professional technical ability can be effectively integrated with practical teaching, thus improving the multi-level practical teaching system.

3.2.3. Deep Integration of School and Enterprise To Promote Comprehensive Practical Teaching

When choosing off-campus practical training and internship bases for students, it would be better to choose large engineering enterprises that are in the leading position in the industry as partners. This will help students learn the brand culture of high-quality enterprises, master their operation process and improve their practical participation. It is necessary to strengthen the in-depth cooperation between schools and enterprises, so instructors need to serve temporary positions in counterpart enterprises. Instructors will improve their frequency and depth of cooperation with engineering enterprises through the experience from the temporary positions, and thus provide students with more convenient practical training and internship opportunities. Colleges and universities should encourage students to participate in the research projects of their instructors, refine their research results, and then, provide cooperative enterprises with "order-based" services after key technological breakthroughs. With these efforts, students' scientific research thinking and practical innovation abilities will be cultivated. As the dual subjects of talent cultivation, colleges and enterprises should jointly study the cultivation mode of compound professionals. For example, cooperative units are encouraged to participate in the formulation and revision of practical teaching programs of colleges and universities, improve the ways and approaches of practical teaching quality evaluation. In this way, the cultivation mode will be innovated for application-oriented talents in engineering.

3.3. Establishing and Improving the Quality Management and Monitoring System of Practical Teaching

It is imperial to standardize working procedures and clarify quality responsibilities to accomplish the objectives of practical teaching and achieve practical effects. In addition, a set of complete and strict teaching management system and quality evaluation standards should be established and enhanced to provide norms and basis for the scientific management of practical teaching. The practical teaching assessment group composed of supervisors from both the university and the enterprise will jointly prepare scientific and standardized practical skills assessment rules that match with the talent training program. Teacher-led teaching and students' subjective practice should be organically combined during practical teaching. As for colleges, they need to intensify the management of practical teaching and clarify the quality responsibility of practical teaching. In turn, a practical teaching quality monitoring system with rich subjects and diversified evaluation will be formed to effectively guarantee the quality of practical teaching links. And each school can determine the specific management system according to the school's needs, such as teaching evaluation system, academic warning and guidance system, practice teaching supervision system and so on. This will further regulate the management of practical teaching and promote the sound development of practical teaching in engineering.

Literally, the traditional single evaluation and assessment method needs to be changed during practical teaching. The process evaluation and result evaluation should be combined into one, and then, the feedback and evaluation of students' practical teaching quality by all parties should be strengthened. Special attention should be paid to the process inspection of practical teaching, while online evaluation of teaching by students and evaluation of teaching by peers and experts should be conducted. First, the college should strengthen the teaching assessment of instructors both on and off campus, and improve the supervision system at both school and department levels. Second, it is necessary to ensure periodic and continuous communication between practice subjects. Last but not the least, the internship enterprises need to feedback in a timely manner to the college about the students' practice and training. Only by establishing a sound quality evaluation system of practical

teaching can we improve the quality of practical teaching.

4. Conclusions

To meet the training requirements of contemporary practical and application-oriented talents, the practical teaching of engineering in colleges and universities must be deeply reformed and innovated. In the development of talent training programs, it is essential to reshape the concept of education, reform the education model, and make better allocation of teaching resources. And in the teaching process, the normative process management should be strengthened and the structure of the faculty should be improved. All the above practices are aimed at cultivating excellent composite professionals with strong ability of theory and practice, which are more suitable for the development of modern economy. Local application-oriented colleges and universities should pay more attention to practical teaching and insist on equal emphasis on theory and practice. When formulating the talent training plan for local application-oriented colleges and universities, factors such as the orientation of the school, major characteristics, the learning ability and psychological state of students and the demand of society for application-oriented talents should be fully considered. By improving the quality management and monitoring system of practical teaching, a set of practical teaching operation mechanism is provided for cultivating application-oriented talents. It is necessary to integrate a diversified practical teaching system, and then strengthen the functions of on-campus organizations of schools, faculties and departments and off-campus organizations of practice bases and in-post enterprises. This forms an organizational structure with full coverage of supervision and guaranteed quality improvement, which will improve the quality of composite professionals cultivation in independent colleges and universities of engineering.

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