

Research on reform of practical teaching system for applied undergraduate engineering students

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Abstract. In response to the low quality of practical teaching in engineering majors, particularly in terms of the effectiveness of experimental teaching, lack of innovation, and other issues, this paper summarizes and analyzes the problems that exist in experimental teaching and innovative practices for cultivating applied undergraduate students, based on the requirements for graduate abilities and knowledge from corporate employers, as well as the situation of engineering practical teaching in China. It explores the composition of various elements in the practical teaching system, standardizes and innovates various elements of experimental teaching activities, and cultivates students' innovative thinking and practical abilities through a multilevel disciplinary competition system, thus constructing an innovative practical teaching system for cultivating applied undergraduate students. The practice has proved that students' practical and innovative abilities are significantly enhanced, their innovative abilities are significantly improved, the quality of graduates' employment is improved, and the social feedback is positive. A large number of high-quality applied undergraduate students have been cultivated for local economic construction.

1 Problem statement

The undergraduate students cultivation goal of local newly established undergraduate institutions is to cultivate applied high-level specialized talents. In recent years, it has been found that students' mastery of professional knowledge and skills is not strong enough, based on graduation thesis defense and feedback from employers [1]. This phenomenon should be given sufficient attention by educators and managers.

The reasons for this phenomenon are as follows: firstly, the traditional practical teaching model, teaching content and methods, as well as practical assessment system, no longer fully meet the requirements of students' practical ability and knowledge enhancement under the current situation of engineering majors. Secondly, from the perspective of practical teaching content, some content is too outdated, some content lacks relevance and fails to integrate well with local realities, and needs to be updated. Thirdly, the traditional practical teaching system lacks clear guidance on students' skills training and knowledge enhancement, and most practical teaching activities lack corresponding

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operational training methods and assessment systems. Most teachers only give examination scores based on experiment reports or course design instructions, failing to reflect students' real performance and level. Fourthly, the innovation ability of most students is insufficient. The overall quality of practical teaching in engineering majors is not high, especially the effect of experimental teaching, which is not very good. Therefore, it is urgent to establish an innovative practical teaching system for the cultivation of applied talents, so as to enhance students' practical and innovation ability [2].

2 Principles and ideas for research on practice teaching reform

2.1 Principles for research on practice teaching reform

Practical teaching is a critical component of improving teaching quality in applied local undergraduate colleges and universities, and is essential for cultivating students' practical abilities and innovation spirit [3]. The construction of the practical teaching reform system should generally embody the following principles:

(1) The practicality principle: It should conform to the actual situations of Liupanshui in Guizhou Province, and provide standardized guidance for students' practical activities.

(2) The operability principle: The establishment of the practical teaching system must be easy to operate, applicable, and easy to form habitual management patterns.

(3) The innovation principle: The establishment of the practical teaching system should not only focus on system innovation but also emphasize students' innovative thinking.

(4) The standardization principle: It should be conducive to the implementation of standardized and standardized management.

(5) The promotability principle: The establishment of the practical teaching system can be used for mining majors and can also be promoted to other engineering majors.

2.2 Research ideas for the reform of practical teaching

Based on research on the ability and knowledge requirements of graduates by employers, combined with the advanced experience of practical teaching modes in other domestic universities' engineering majors, and carefully summarizing the experience of our college's school-enterprise cooperation in engineering majors, as well as the various problems encountered by students when applying theory to practice, we seek new models of school-enterprise cooperation and new mechanisms for on-the-job internships, and explore the reform of practical teaching content and modes. The guidebooks for practical teaching in engineering majors had written, propose specific internship teaching reform measures, and formulate internship teaching standards based on these measures, standardizing and institutionalizing the management of internship teaching. Teaching materials had published to guide student practical teaching, while cultivating students' innovative thinking and practical skills through multi-level discipline competitions.

In response to the situation where the practical teaching content is somewhat outdated, lacks relevance to local circumstances, we will develop internship syllabi and guidebooks that are both relevant to local circumstances and advanced. These materials will be based on local economic and social realities.

In response to the practical problem of the lack of corresponding operational training methods and assessment systems in most practical teaching activities, the assessment method has been reformed to focus on process assessment, taking into account the assessment results from enterprises. This objective evaluation of the effectiveness of practical teaching will guide the requirements for the next practical teaching step.

To address the problem of non-standard experimental teaching, regulations have been introduced to strengthen teaching management, standardize the management of student experiments, ensure the achievement of internship teaching objectives, and urge students to learn and consolidate their knowledge, improve their application ability, and further improve the quality of internship teaching.

By implementing reform measures in practical teaching and combining them with changes in the methods of practical teaching assessment, the students' practical activities are objectively and truthfully reflected. This fully stimulates students' enthusiasm for learning and their proactive initiative, transforming practical activities from passive to active, and thus cultivating students' innovative practical abilities.

With the focus on enhancing students' practical and innovative abilities, a "multi-level and three-dimensional" subject competition system covering mining engineering has been gradually established through exploration and practice, consisting of four stages, four levels, three categories, and three abilities. Meanwhile, the competition is combined with practical teaching, integrating the subject competition work with experiments, professional course design, and concentrated practice to form a practical teaching format based on subject competition and aimed at cultivating applied innovative talents, further improving students' practical and innovative abilities.

Ultimately, an innovative practical teaching system for cultivating applied talents, centered on the innovative practical teaching system and "multi-level and three-dimensional" subject competition system, has been established. It comprises a complete practical teaching system from goals to content to methods to assessment and evaluation, covering recognition internships, production internships, course design, graduation internships, graduation design, and subject competitions.

3 The significance of practical teaching reform

3.1 The need for practical teaching in the school's educational positioning

As a local applied undergraduate university, the school has clearly defined the objectives and ideas for cultivating applied talents based on its educational positioning, which is of great significance for the development of the local economy and society. Practical teaching is the core content of applied undergraduate education and plays a vital role in cultivating applied talents. To cultivate applied talents, it is essential to emphasize the importance of practical teaching, emphasizing the need for students to have a solid theoretical foundation, strong practical skills, innovative spirit, and cooperation awareness. Practice is an important means of training for the comprehensive ability and innovative capacity of talent cultivation. Therefore, the reform of the practical teaching system and the cultivation of students' innovative abilities are particularly important [4].

3.2 The need for building a practical teaching guarantee system

Practical teaching is an important part of the higher education teaching system and an effective way to cultivate students' basic skills, practical abilities, and innovative spirit. Serving the local economic and social development and meeting the practical needs of the industry is the foundation of local applied undergraduate colleges [5-6]. Cultivating students' knowledge application and practical operation abilities is the fundamental starting point for talent cultivation in local applied undergraduate colleges. Applied talents with deep basic knowledge and stronger practical abilities than vocational college students and traditional undergraduate students are the advantages of local applied undergraduate talent

cultivation. Therefore, practical teaching plays a crucial role in the talent cultivation process of local applied undergraduate colleges. Currently, there are still many problems in the practical teaching of engineering majors in colleges, and students' practical application abilities cannot be effectively improved. The normal operation of practical teaching is not guaranteed, and students cannot carry out practical operations and on-site practices in a timely manner. The construction of the practical teaching system is not reasonable, the formulation and implementation of teaching plans, and the evaluation of teaching quality are not in place. There are no unified standards for practical teaching, and monitoring and management are not standardized enough [7-8]. The evaluation of practical teaching is unscientific and cannot truly reflect students' practical teaching level, which greatly dampens students' initiative to engage in practical learning. Therefore, educational reform is of utmost importance for building a practical teaching guarantee system for cultivating applied talents and developing students' innovative ability [9].

4 The implementation process of practical teaching reform

4.1 Research and surveys on universities and enterprises

Conducted research on the status and effectiveness of practical teaching in three engineering majors at universities in China, and surveyed four employers' requirements for the knowledge and abilities of graduates from engineering majors. The contents includes the status and effectiveness of practical teaching in engineering majors at universities in China, as well as the requirements of employers for the knowledge and abilities of graduates from engineering majors.

4.2 Organizing and discussing of practical teaching content

According to the research results, the organization and discussion of practical teaching content were mainly conducted from the following aspects:

Determine the qualities, skills, and knowledge that students should possess through each practical stage and form a systematic practical teaching content, i.e. what skills and knowledge students need to acquire through practical activities.

Through internships, students can understand the production technology and development status of enterprises, recognize and understand the production process and major production links of enterprises, lay the foundation for production in combination with the study of professional courses. Through internships, students can strengthen their perceptual understanding of the main production links of enterprises, clarify the important position of engineering industry in the national economy, understand the important role played by engineering and technical personnel in enterprises, further cultivate and improve students' ability to identify, analyze and solve problems, learn some scientific and technological and management knowledge in production, and establish a professional thinking to contribute to the industrial modernization.

Through experiments, students can systematically verify the basic theoretical knowledge and professional theoretical knowledge they have learned, consolidate and expand their knowledge, skills in calculation and drawing, cultivate and improve their ability and quality to analyze and solve practical problems, and cultivate and exercise their good ideological style of loving labor, connecting theory with practice, and respecting science and practice.

4.3 Constructing the multilevel discipline competition system

Centered on improving students' practical and innovative abilities, a multilevel discipline competition system has been gradually established, consisting of four stages, four levels, three categories, and three types of abilities, guiding students to participate in practical work competitions and complete college innovative practice projects.

The main measures to construct a multilevel discipline competition system are as follows:

(1) Strengthen the construction of discipline competition projects at the four levels. From the departmental level to the national level, the construction of discipline competition projects at the four levels is strengthened. A layered competition project is constructed, including departmental, university-level, provincial (municipal)-level, and national-level competitions, forming a multi-level selection mechanism.

(2) Combination of competition and practical teaching. We integrate discipline competitions into daily practical teaching activities, and organically integrate discipline competition work with experiments, professional course design, and concentrated practice to form a practical teaching form based on discipline competition and aimed at cultivating applied innovative talents. The ultimate goal is to promote teaching, learning, and training through competitions.

(3) Combination of competition and laboratory opening. Combining various discipline competitions, open experimental projects are designed to attract more students to participate in discipline competition activities through elective open experiments, and closely integrate laboratory opening with discipline competitions.

(4) Combination of foundation and specialty. We emphasize the role of discipline competitions in combining basic knowledge and professional knowledge, especially comprehensive competition projects are the best carrier for combining foundation and specialty. Through the training of comprehensive competition projects, students combine the basic and professional knowledge they have learned, achieve systematic integration of knowledge, and achieve knowledge integration between various courses. Students' design ability, innovation ability, and application practice ability have been greatly improved.

5 Summary

After years of effort, research on the practical aspect was conducted, content was determined, and reforms were implemented to standardize and innovate laboratory teaching. At the same time, through the multi-level subject competition, innovative thinking and practical abilities were developed among students. Both practical teaching and subject competitions were explored and practiced to enhance students' practical and innovative abilities. Finally, an innovative practical teaching system was established for the training of applied talents in engineering majors. After years of research and practice, the social effects have been excellent, and students' practical and innovative abilities have significantly improved. Professional students have won numerous awards in national competitions, and the employment rate and social feedback have been positive. A large number of highly qualified applied talents have been trained for local economic development.

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