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Research on the Teaching Reform of Professional Practical Courses under the Background of Emerging Engineering Education

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Abstract: With the in-depth development of emerging engineering education, higher education has put forward higher requirements for the cultivation of engineering professionals. Professional practical courses are an important part of undergraduate teaching plans, aiming to improve students' practical abilities and their ability to comprehensively apply professional knowledge. To further explore teaching reform and improve the diversified curriculum assessment and evaluation system, this paper proposes a series of teaching reform methods for professional practical courses. It reforms the content and teaching methods of professional practical courses. On the basis of introducing practical application scenarios and cutting-edge technologies, it adds interdisciplinary modules, makes full use of internal and external school resources to break traditional disciplinary boundaries, and integrates interdisciplinary content from cutting-edge fields such as artificial intelligence, big data, and biotechnology. This enhances students' understanding of industry needs, practical operation capabilities, and awareness of multi-disciplinary integration. Secondly, it promotes a student-centered teaching model, increases students' opportunities for independent participation, and cultivates their independent thinking and innovation abilities. At the same time, it reforms the evaluation system: by comprehensively considering students' performance and achievements in the process of professional practical courses, it measures students' abilities more comprehensively through a multi-dimensional evaluation system. This study provides new ideas for the teaching of professional practical courses.

Keywords: Professional practical courses; Interdisciplinary integration; Teaching reform; Evaluation system

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1. Introduction

The professional practical course focuses on completing a comprehensive and applied computer program development project that involves professional course knowledge. It is a purposeful, planned, and structured practical teaching link [1]. This course requires students to have solid basic knowledge and strong practical operation abilities, such as the standardization of code writing, the efficiency of program debugging, and the integrity of function implementation. From the perspective of achievement requirements, students generally need to submit a fully functional and operable complete system, as well as supporting materials, including requirement documents, design specifications, and user manuals.

To promote the continuous reform and innovation of engineering education and better meet the industry's requirements for the practical abilities of computer talents, reforms and explorations have been carried out on aspects of the professional practical course, such as teaching content, teaching mode, teaching methods, and assessment and evaluation methods. Through practice, the reforms have achieved remarkable results: they not only effectively improved the teaching quality of the course, but also made the teaching effect more in line with the actual needs of cultivating students' professional abilities.

2. Problems existing in the current curriculum design

In the current teaching of professional practical courses, there exist a series of problems. These problems not only restrict the improvement of teaching quality, but also greatly affect the in-depth cultivation of students' practical abilities and the effective stimulation of their innovative thinking, resulting in a significant gap from the training objectives of applied talents under the background of emerging engineering education.

The content of professional practical courses has obvious deficiencies in both depth and breadth. On one hand, the existing teaching content mostly stays at the level of simple application of basic theories, and the teaching resources are mainly traditional textbooks and outdated cases. It lacks connection with cutting-edge industry technologies and real enterprise development scenarios, failing to accurately reflect the current industry's actual requirements for talents' abilities. On the other hand, the content design fails to take into account the diversified development needs of students: it lacks progressive guidance content for students with weak foundations, and also lacks expanded challenging tasks for students with outstanding abilities. More importantly, the interdisciplinary content is seriously insufficient, failing to break the boundaries of traditional disciplines. This makes it difficult for students to obtain sufficient practical training in the course [2].

The traditional teaching mode is teacher-centered, where students passively receive knowledge and complete designated tasks step by step, lacking autonomy and innovation [3]. Such teaching mode and methods are not scientific or reasonable enough, and cannot meet students' practical needs or the requirements for cultivating innovative thinking [4]. Additionally, the existing evaluation mechanism for professional practical courses often focuses only on results, while ignoring the comprehensive assessment of the practical process. As a result, it fails to better measure students' practical abilities.

3. Basic ideas for reform

3.1. Designing practical teaching content based on vocational ability cultivation

To closely align with actual industry needs and cutting-edge technologies, optimize curriculum design, and cultivate high-quality talents meeting social demands, the reform is carried out mainly through the following aspects:

(1) Combine practical application scenarios and select projects with practical significance as topics for professional practical courses. These topics can originate from enterprises, society, teachers' research projects, or be independently designed based on teaching content and students' actual abilities. Through practicing these topics, students can enhance their understanding of computer application fields and

improve their application skills and practical abilities;

(2) Deepen interdisciplinary integration reform and break disciplinary barriers based on the concept of integrating professionalism and innovation. Fully integrate multi-disciplinary resources inside and outside the university, and incorporate cross-field scenarios such as artificial intelligence and medical data analysis, big data and financial risk control, and computer technology and bioinformatics processing into project design. Meanwhile, build an interdisciplinary collaboration platform, encourage students to form multi-background teams to complete designs, and cultivate compound application abilities through the collision and application of interdisciplinary knowledge;

(3) Reasonably arrange the progress and schedule of professional practical courses according to the difficulty level of the course content and the involved knowledge points. In professional practical courses, full consideration should be given to the time constraints and students' actual abilities to ensure that students can complete the design tasks within the specified time while covering the required knowledge and skill points;

(4) Design topics of varying difficulty for students at different levels to meet their diverse learning needs. For students with weaker foundations, relatively simple topics can be selected to strengthen their basic training; for students with stronger foundations, more challenging topics can be chosen to cultivate their innovative abilities.

3.2. Student-centered reform of teaching methods

Diversified teaching methods are introduced to improve teaching effectiveness and enhance students' learning interest and participation. Specific measures include:

(1) Split the content of professional practical courses into multiple subtasks, allowing students to discuss and collaborate in groups, design and discuss works in stages, thereby training their abilities to discover, analyze, and solve problems. Each course session should aim to acquire new knowledge, solve problems, optimize and reconstruct teaching content based on theoretical knowledge, with the ultimate goal of improving students' hands-on skills. In the process of problem-solving, students' teamwork spirit is also cultivated;

(2) In class, instructors communicate with students to solve specific problems in projects. After class, students make full use of high-quality internet resources to address technical difficulties encountered. Instructors organize students to report phased achievements at key time nodes to timely guide them to complete design tasks with guaranteed quality and quantity. The professional practical course plans are flexible and diverse; instructors stimulate students' curiosity and desire for knowledge by planning and explaining the design process, gradually guiding them to practice learned computer professional knowledge on new software and hardware platforms, with a focus on cultivating students' innovative awareness.

3.3. Student-centered reform of teaching methods

To accurately reflect students' learning status and teachers' teaching effects, a comprehensive and objective teaching evaluation system is constructed, covering the following multi-dimensional evaluation methods:

(1) By evaluating the works submitted by students, we can understand the depth of their mastery of course knowledge points and their practical application abilities. These works cover core contents such as programming codes, system design documents, and user manuals, among which, programming codes

focus on syntax standardization, function implementation degree and logical rigor; system design documents pay attention to architecture rationality and module division clarity; user manuals examine the practicality and understandability of operation guidelines. Through these aspects, it verifies students' ability to transform theoretical knowledge into computer practical training achievements from multiple perspectives;

(2) By evaluating students' practical training reports, we can understand their level of understanding of the course content and their ability to think independently. The content of the report can cover multiple aspects: learning reflections include the transformation of programming ideas and the process of overcoming technical difficulties during practical training; knowledge point analysis includes the interpretation of programming language syntax and system architecture principles; case analysis involves the logic of analyzing real industry application cases based on practical training projects; in addition, it can also include problem summaries in code debugging and optimization ideas for system deployment. Through these dimensions, it can fully reflect students' absorption and thinking of the computer practical training content, and avoid the evaluation being only superficial;

(3) In practical teaching links such as experiments and professional practical courses, by observing students' specific performance, we can understand their practical abilities in aspects like programming and development, equipment debugging, and system deployment, as well as their operational skills in the implementation of programming standards and the application of professional tools;

(4) By observing students' specific performance in group discussions, such as whether they take the initiative to share opinions, can listen carefully to others' views, will mediate team differences, and have clear and organized expression of ideas, we can comprehensively understand students' teamwork ability and communication ability. This makes the evaluation more in line with the actual discussion scenario and avoids vague judgments;

(5) Organize students to carry out two-way evaluation activities as through self-evaluation, guide students to sort out the achievement of their own learning goals, identify weak links in knowledge and skills, and explore room for optimizing learning methods, so as to improve their self-awareness and autonomous learning consciousness. On the other hand, through peer evaluation among students, encourage them to objectively assess others' strengths and weaknesses from the perspectives of knowledge mastery, practical performance, and teamwork. In the process of communication and feedback, students can learn from others' experiences, recognize their own problems, and ultimately promote their autonomous learning and mutual progress.

4. Reform effects

Taking the "computer game design practical training" course as an example, the quality of projects submitted by students has significantly improved. Most of the students' works are related to enterprise projects, and students have made progress in innovation and entrepreneurship capabilities. More than half of the students applied for the university's innovation and entrepreneurship projects and successfully completed them. Additionally, 15% of the students participated in teachers' research projects, a proportion that has increased by 10% compared with before the reform.

In the end-of-semester teaching satisfaction survey, students gave positive feedback on their satisfaction with the "computer game design practical training" course. This reform has also played a promoting role in the subsequent secondary project training and graduation design. The reform has created conditions for students to master professional knowledge and skills proficiently, enabling the trained talents to meet market demands. By combining teaching content that is more closely aligned with practical scenarios and enterprise needs, students not only possess solid professional knowledge but also master skills highly compatible with industry requirements. This has enhanced their competitiveness in the job market and ensured that graduates can achieve full employment.

5. Conclusion

Based on the construction of first-class application-oriented undergraduate programs under the background of emerging engineering education, this study conducted systematic exploration of teaching reform to address the problems existing in professional practical courses. Through multi-faceted reforms in curriculum content, teaching methods, and evaluation mechanisms, especially the integration and practice of interdisciplinary content, the students' practical abilities, innovative thinking, and autonomous learning capabilities have been significantly enhanced. Meanwhile, the effectiveness and pertinence of course teaching have also been improved.

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