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Research on Innovation and Entrepreneurship Teaching Reform of Electronic Technology Courses under the Ideological Guidance, Innovation-Driven and Integration of Courses and Competitions

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Abstract: Electronics is a core curriculum in engineering education. Traditional teaching models face multiple challenges, notably the inadequate integration of ideological and political education, weak ideological and political elements, a lack of student learning motivation, and a disconnect between theory and practice. This paper proposes a teaching reform pathway centered on ideological guidance, innovation and entrepreneurship, and course-competition integration. Through the construction of ideological and political resource repositories, blended teaching models, course-competition integration, and diversified assessments, a holistic educational system has been formed to achieve the organic unity of knowledge transmission, ability cultivation, and value shaping. Practices have proven the model's effectiveness in boosting students' self-directed learning, engineering skills, and innovative mindset, alongside enhancing teachers' teaching proficiency. Significant results have been achieved through multiple rounds of teaching practice.

Keywords: Electronics; Course-Competition Integration; Blended Teaching; Innovation and Entrepreneurship.

1. Introduction

The ultimate goal of education is to foster virtue and cultivate talent. Within the new educational paradigm of "Three-All Education" (all-person, all-process, all-round education), the innovative direction and essential imperative of electronics course reform are the holistic synthesis of knowledge acquisition, competency cultivation, and character development. Electronics is a core course in engineering education. Its difficulty stems from the abstract professional terminology, symbols, formulas, and the strong practical orientation toward engineering. The predominant reliance on classroom lectures in traditional teaching leads to one format. In recent years, due to educational reforms and the growth of the Internet, blended learning has become the dominant teaching approach [1]. The adoption of a project-driven instructional model based on the OBE framework can likewise serve to enhance students' learning initiative, reinforce their engineering mindset, and foster their capacity for innovation [2]. In terms of the integration of the evaluation system with theoretical and practical teaching, Chinese universities have also conducted research and practice on curriculum teaching reform [3]. As artificial intelligence emerges, smart teaching is also being integrated into electronics course instruction [4].

Some inherent difficulties in electronics courses continue to elude fundamental resolution. (1) In the balance between teaching and learning, although the focus has gradually shifted toward student-centered autonomous learning, students still suffer from a lack of intrinsic motivation and weak willpower, requiring effective ideological and political guidance [5]; (2) Due to limitations in teaching conditions, it is difficult to achieve outcome-oriented teaching and realize the deep integration of theory and practice; (3) The course evaluation system lacks effective tools to assess students' design skills and innovative thinking, hindering the true implementation of a student-centered teaching approach. The organic and effective integration of course learning with competition activities can enhance students' practical abilities, innovative spirit, and sense of cooperation. Furthermore, when guided by ideological and political education, this course-competition integration can serve as an effective approach to addressing the key pain points in the teaching reform of electronics courses.

2. Ideological and Political Education Guided blended Online-Offline Teaching

Guided by the teaching philosophy of "fostering virtue, learner-centered and outcome-oriented", course-based ideological and political education is integrated throughout classroom teaching and competition guidance. Furthermore, a unified resource bank for this is developed, integrating books, courseware and online resources. Using engineering practice, students build a diligent attitude, a rigorous work ethic, and independent problem-solving skills [6]. Using knowledge points as an entry point, ideological and political elements are identified within each teaching module and organically integrated into instruction, allowing values education to occur subtly within the teaching of professional knowledge [7]. Based on the blended online-offline teaching model illustrated in Figure 1, the ideological and political content of the course is carefully designed to effectively integrate both online and offline components. In the practical component of electronics instruction, students are encouraged to develop engineering thinking, fostering an organic integration of values education with the cultivation of practical electronics skills. During the organization of and participation in competitions, values education is infused to cultivate students' sense of healthy competition and their ability to collaborate [8]. Teams that achieve success should be encouraged to continue improving, while those that face setbacks should be guided to summon renewed determination. This approach realizes the effective integration of values education and competition guidance.

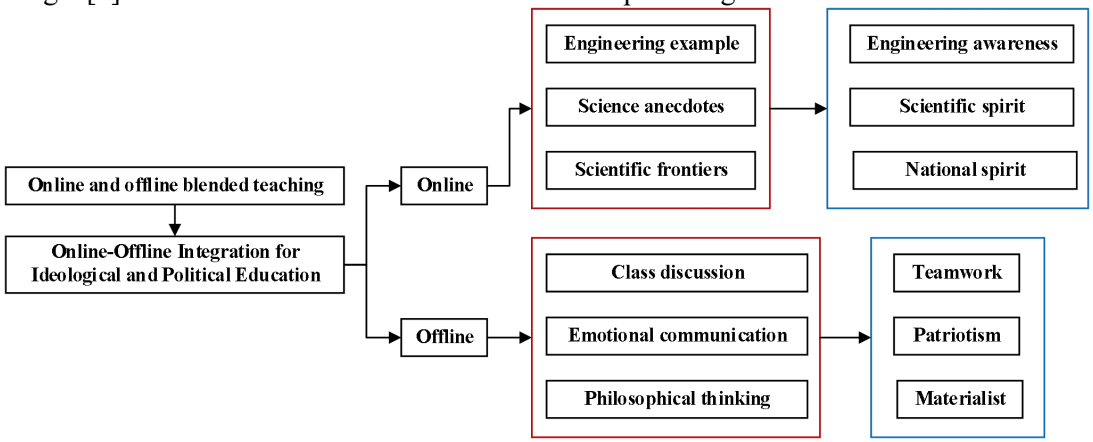

Figure 1. Online-Offline Integration for Ideological and Political Education

3. Teaching and Competition Accomplish Resource Integration, Process Integration, and Competency Integration.

Relying on competitions as a vehicle, this approach implements the strategies of "promoting learning through competitions, promoting teaching through competitions, and promoting reform through competitions" to enhance the classroom quality of electronic technology courses, thereby constructing the talent cultivation model shown in Figure 2.

Constructing a competition-driven environment that integrates "in-class design and testing competitions" with "extracurricular academic competitions at the university, provincial, and national levels", this approach leverages competitions to drive the teaching process, cultivate students' collaboration and communication skills, and foster their sense of dedication to the country and society [9]. Through research on curriculum systems and teaching models, MOOC resources for electronic competitions are developed. The curriculum follows a progressive difficulty principle, guiding students from imitation to improvement and ultimately to independent innovation [10]. The three core courses—Electronic Technology, Electronics Practice, and Electronic Design Methods and Production—are organically connected and integrated. In alignment with corresponding academic competitions, a "virtual-actual combination" experimental and practical process is implemented, bridging classroom teaching with the cultivation of innovative and application-oriented talents.

Students are actively guided and effectively organized to participate in electronic design competitions held by the university. For different majors, discipline-specific competition resource repositories are established. Through participation in competitions, students engage in mutual learning and exchange, fully stimulating their innovative potential. The "course-

competition integration" model enables students to learn course content while simultaneously participating in corresponding competitions, achieving synergistic development of "electronic technology knowledge, electronic design capabilities, and scientific engineering literacy." This comprehensive approach enhances students' overall abilities and helps them develop a clearer understanding of their future career directions.

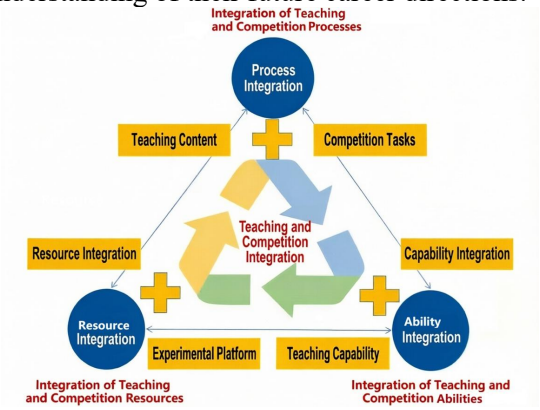

Figure 2. Talent Cultivation Model Integrating Competition and Teaching

4. Establish a Curriculum Assessment System that Integrates Courses, Competitions, and Innovation & Entrepreneurship.

Guided by the Outcome-Based Education (OBE) philosophy, establish a diversified course-competition assessment and evaluation standard that is whole-process and all-round, capable of respecting students' interests and inspiring their self-confidence, the overall architecture is shown in Figure 3.

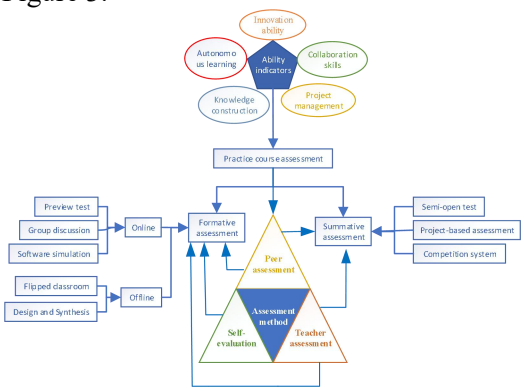

Figure 3. Assessment Mechanism for Course-Competition-I&E Integration

Unify academic assessment with practical evaluation, synchronize classroom testing with competition assessment, and combine capability evaluation with innovation assessment. In accordance with the university's management regulations for competition and innovation entrepreneurship experiments, we introduce credit points for the Electronic Design Contest and I&E project applications. This approach evaluates students' engagement in the entire course competition innovation process, organically integrating these elements into a synergistic force within the teaching and learning journey.

In designing the evaluation framework, it is crucial to integrate a diverse set of assessment metrics, encompassing theoretical foundations, electronic design, practical application, innovative thinking, management and teamwork, as well as communication proficiency [11].

The evaluation is categorized into two types: formative and summative. Formative evaluation tracks the students' autonomous learning process, while summative evaluation assesses their specific learning outcomes. Students are encouraged to analyze and summarize their own learning journey, reflect on their effectiveness, and develop self-evaluations. Furthermore, peer assessment is introduced to foster mutual learning and cultivate critical thinking through mutual critique.

In the review of student innovation and entrepreneurship projects, emphasis is placed on the application prospects, technical depth, and innovativeness of the work. Competition performance is evaluated from multiple perspectives, like technical implementation, creativity, teamwork, and demonstration.

A continuous feedback loop for improvement is established, adjusting the evaluation system based on input from students, teachers, and industry experts. Meanwhile, the evaluation data can be applied to curriculum reform and teaching enhancement, providing a solid basis for future directions.

5. Mutual Promotion between Teaching and Competitions; Synchronization of Project Discovery and Mentor Cultivation.

Leveraging student organizations such as the Electronic Competition Association and other science and technology clubs, students are organized to participate in and conduct competitions both within and outside the curriculum. An innovation competition team selection system is established, which guides students' motivation and interests towards participation, ensuring their sustained interest in innovative projects. Establish a three-in-one tiered training system consisting of Basic Training Elite Cultivation Innovation Teams.

Integrating participation in science and technology club activities and science and technology competition practices as important avenues for curriculum teaching, through the management and conduct of the Electronic Competition Association, cultivate students' awareness of communication and collaboration, provide platforms and opportunities to promote their initiative. By utilizing the resources of the Provincial Experimental Demonstration Center, we foster a student-driven ecosystem of mutual guidance and self-management, forming a well-structured echelon for academic competitions. Establish extensive communication channels to cover the entire student body. By utilizing WeChat groups, QQ groups, and official accounts, we can promptly gather student feedback and stay updated on their status.

In conjunction with the university's electronic design contests, we organize various sub-competitions, such as Microcontroller (MCU) contests. These small-scale projects allow us to gauge students' learning progress in a timely manner, which in turn helps us rationally plan classroom teaching schedules and feed valuable insights back into curriculum reform and research.

6. Effectiveness of Curriculum Reform

Based on years of practical experience in electronic technology courses, we have developed a pedagogical approach with corresponding teaching methods and a systematic implementation framework. Following initial successes, this model has been widely promoted. As curriculum reform deepens, we continuously refine our teaching methods, enrich course resources, and perfect our reform strategies. Over the past four years, the overall assessment scores of Electronic and Information Engineering majors at our university have shown a steady upward trend, with a significant decrease in the failure rate.

Students have achieved numerous national and provincial awards in various competitions, including the National Undergraduate Electronics Design Contest, the 'Challenge Cup', and the Optoelectronics Contest. The number of student-led innovation and entrepreneurship projects has also increased year by year. Furthermore, students have demonstrated greater initiative and classroom engagement, while their innovation capabilities and spirit of collaboration have been effectively cultivated.

7. Conclusion

The Electronic Technology course is a core foundational course for electrical and electronic engineering majors. The teaching team of Electronic Technology, guided by the principle of "cultivating morality and fostering talent", has explored and formed a teaching model for Electronic Technology instruction characterized by "ideological and political education leadership, innovation and entrepreneurship-driven approach, and integration of classroom learning with competitions". This model has played a positive and effective role in enhancing students' learning motivation, practical innovation capabilities, and collaborative awareness. It has also improved teachers' professional competence, achieved mutual promotion between teaching and learning, and holds significant reference value for practical-oriented engineering courses.

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