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Research on the Cultivation Model for Innovation and Entrepreneurship Ability in College Students Driven by High-level Discipline Competitions

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Abstract

Under the background of constructing new engineering disciplines, discipline competitions, as an essential carrier for developing students' innovative problem-solving skills and engineering literacy, are emerging as a pivotal approach to cultivating innovation and entrepreneurship capabilities. This article focuses on key factors influencing the cultivation of innovation and entrepreneurship capabilities among materials science majors. It proposes taking high-level competitions as the driving force to stimulate students' awareness, optimize the curriculum system, build a three-mentor training team, improve the innovation ecosystem and multi-feedback evaluation system, and establish a competition-oriented cultivation model. This framework promotes the exploration of innovative talent cultivation in new engineering disciplines, providing a reference for developing capabilities of materials professionals within this context.

Keywords

New engineering, innovation and entrepreneurship, discipline competitions.

1. Introduction

Since the Ministry of Education launched the Fudan Consensus in 2017 to propose a blueprint for the construction of new engineering disciplines, and in 2020, the Tian Da Action released ten reform paths, China's higher engineering education system has undergone a paradigm shift driven by innovation [1]. In this strategic transformation, the construction of new engineering disciplines and innovation and entrepreneurship education have shown a deep coupling relationship. The former provides structural support for the cultivation of innovation and entrepreneurship capabilities by reconstructing the interdisciplinary curriculum system and building a collaborative platform for industry, academia, and research. The latter, through problem-oriented practical teaching and market-oriented thinking training, promotes the transformation of the new engineering talent cultivation model from technology output type to value creation type in a demand-driven manner.

The construction of new engineering disciplines is closely related to innovation and entrepreneurship education. Cultivating innovative and entrepreneurial talents is not only an important foundation for the country's innovation-driven development and the construction of an innovative nation, but also a key measure to promote the reform of higher education teaching in China, enhance students' comprehensive employment abilities, and expand employment channels [2].

With the implementation of national strategic plans such as Made in China 2025, Industry 4.0, and Intelligent Manufacturing, as well as the transformation and upgrading of traditional materials industries and the rise of new materials industry ecosystems, higher requirements

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have been posed for the cultivation of talents in materials-related majors. Materials-related students need to possess solid professional knowledge as well as excellent innovative and entrepreneurial thinking and capabilities against the backdrop of continuously deepening the construction of new engineering disciplines [3-4]. Therefore, how materials science students can not only master professional knowledge but also develop creative awareness, enhance innovation-entrepreneurship capabilities, strengthen entrepreneurial skills, and effectively address societal needs for interdisciplinary talents has become a shared concern among educational administrations, universities, enterprises, and institutions. Against the backdrop of comprehensively deepening higher education reform through new engineering initiatives, discipline-specific competitions serve as both a crucial platform for cultivating students' innovation-entrepreneurship capabilities and a key bridge for extending theoretical pedagogy.

2. Current Problems in Innovation-Entrepreneurship Education for Materials-Related Students

(1) The awareness of innovation and entrepreneurship among Materials-related students is insufficient, while the atmosphere for innovation and entrepreneurship stays inadequate, and their enthusiasm for disciplinary competitions remains low. The current phenomenon of deficient awareness innovation and entrepreneurship awareness among college students majoring in materials science reflects the multi-dimensional structural contradictions in the education system. Firstly, a structural conflict exists between intergenerational cognitive inertia and industrial transformation demands. Traditional family education perpetuates a transgenerational cognitive schema prioritizing occupational stability, which contradicts the innovation agility required in new engineering contexts. This misalignment results in deficient innovation-entrepreneurship awareness and an underdeveloped ecosystem among students. Secondly, resource allocation imbalances between elite training models and inclusive education exacerbate systemic inequities. This disparity suppresses participation enthusiasm across the majority student population.

(2) Systemic connections are absent among theoretical courses, comprehensive experiments, innovation-entrepreneurship practices, and disciplinary competitions. At the theoretical course level, knowledge delivery remains confined to the linear progression of textbook content, failing to integrate interdisciplinary knowledge based on competition requirements. Consequently, students demonstrate significant deficiencies in understanding cutting-edge and cross-disciplinary competition themes. The professional laboratory section remains focused on verification-based experiments and standardized procedures. The alignment between project-based experiments and competition requirements has not been established, which hampers students' ability to convert experimental outcomes into innovative competition entries.

(3) Faculty members lack hands-on engineering experience, while industry mentors rarely engage in disciplinary competitions. Currently, a significant structural imbalance exists between faculty engineering practice proficiency and the industry relevance of disciplinary competitions. The predominant school-to-school career trajectory among teachers creates deficiencies in critical competencies, including engineering problem abstraction skills and technology translation thinking. Furthermore, the current disciplinary competition guidance system suffers from a structural deficiency due to insufficient industry mentor involvement. Most mentors merely offer preparatory briefings rather than providing sustained engagement throughout the project research and development lifecycle.

(4) The disciplinary competition-based system for cultivating innovation entrepreneurship talents remains underdeveloped. The current institutional framework for cultivating innovative talents through disciplinary competitions retains systemic flaws, manifesting a structural disconnect between advanced top-level design concepts and deficient grassroots

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implementation mechanisms. Although the Ministry of Education and universities have issued strategic policy documents such as the Implementation Plan for Deepening Innovation-Entrepreneurship Education Reform, operational institutional systems exhibit an inverted pyramid imbalance. Resource allocation authority resides primarily with university-level academic affairs offices, while implementing colleges have limited decision-making participation, creating a policy implementation gap through hierarchical attenuation.

3. The Cultivation Approaches to Enhancing The Innovation and Entrepreneurship Capabilities of Students Majoring in Materials

(1) Cultivate students' innovation-entrepreneurship awareness and enhance their engagement in disciplinary competitions. Cultivating students' holistic innovation-entrepreneurship awareness is foundational for capability development. Consequently, we propose leveraging second classroom initiatives through three complementary approaches: (a) online learning platforms, (b) industry expert lectures, and (c) student entrepreneurship clubs. This integrated strategy stimulates competition-driven innovation consciousness. Innovation-entrepreneurship activities require robust foundational competencies and high practicality. To afford students sufficient practical engagement time, universities should deliver theoretical courses via cloud platforms. This allows flexible scheduling while enabling team-based project assessments. Such integration reinforces theoretical knowledge and enhances practical capabilities. The influential power of role models is immense. Inviting industry experts, scientists, and distinguished faculty to deliver innovation-entrepreneurship lectures and share practical experiences effectively stimulates students' engagement in such initiatives. Furthermore, student interest groups enable all participants to join communities aligned with their aspirations. Guided by university and departmental administrations, these groups periodically organize innovation-entrepreneurship competitions with awards determined at institutional levels. Members achieving competition success receive preferential consideration in graduate admissions and scholarship evaluations, thereby mobilizing engagement and stimulating innovation passion.

(2) The curricular framework reform integrating theory-practice with innovation-entrepreneurship, driven by disciplinary competitions. Revise the talent cultivation plan for materials science majors by: (a) optimizing theoretical, practical, and innovation-entrepreneurship course modules; (b) constructing disciplinary competition-aligned core course clusters. This establishes dynamic alignment between curricula and disciplinary competitions. Theoretical courses integrate frontier knowledge of emerging materials and advanced manufacturing technologies. Contextualized instruction via video demonstrations and simulations enables students to identify entrepreneurial opportunities inherent in technological advancements. In practical courses, instructors design competition-aligned projects and strategically integrate disciplinary competition elements. This enables pedagogical synergy between theoretical and practical instruction, strengthening students' innovation-entrepreneurship capacities. For innovation-entrepreneurship courses, institutions should leverage both campus-based innovation platforms and external open-access resources. Targeting critical research challenges faced by industries, these courses integrate competition-driven innovation projects. This ensures the innovation-entrepreneurship curriculum and competency development permeate theoretical and practical modules, building a distinctive system emphasizing fundamentals, application, practice, competitions, and innovation.

(3) Establish a three-mentor system involving theoretical course teachers, practical course teachers, and enterprise mentors to jointly guide students. The three mentors first identify the distinctive research directions. During the teaching process, the theoretical course teachers introduce the latest research progress and achievements within these distinctive research

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directions into the classroom, allowing students to understand the purpose, capabilities, methodologies, and potential impact of each distinctive research direction. Based on these directions, students learn general research, innovation, and entrepreneurship principles. This approach also stimulates students' desire for innovation and thirst for knowledge. Practical course teachers, building upon the refined distinctive research directions, collaborate with industry mentors to identify pressing engineering challenges within these domains. Aiming for participation in high-level academic competitions, they cultivate students' practical skills and innovative capabilities through comprehensive end-to-end engineering practices. In the teaching process of theoretical and practical courses, collaboration with enterprise mentors facilitates a series of activities such as teachers and students entering enterprises and enterprise mentors entering classrooms. On the one hand, these activities broaden the horizons of instructors, update their perspectives, and enable teaching improvements aligned with production realities. On the other hand, they enhance students' understanding of project-related production processes while strengthening their knowledge of corporate structures and operations.

(4) Refine the innovation and entrepreneurship cultivation system centered around disciplinary competitions. It is proposed to establish a collaborative framework linking the university's functional departments, colleges, and the three mentors. The functional departments oversee the top-level design of the academic-competition-driven innovation cultivation system, while individual colleges implement specific operational management. The three mentors analyze academic competition rules, design student-tailored entries through discussions, and guide students in performing experimental/practical tasks. Students then analyze outcomes and develop innovation competition deliverables.

4. Conclusion

Based on an exposition of the significance of disciplinary competitions for cultivating talents in materials-related majors and considering the status of innovative-entrepreneurial talent development, this article proposes stimulating students' innovation-entrepreneurship awareness and mobilizing their participation enthusiasm through three dimensions: cloud classrooms, off-campus mentors' lectures, and student entrepreneurship clubs. Concurrently, it advocates optimizing the theory-practice-innovation curriculum system, establishing a disciplinary-competition-based three-mentor system, improving the innovation-entrepreneurship ecosystem, and exploring a multi-level management system with multi-feedback and comprehensive evaluation-thereby forming a distinctively featured model for cultivating innovation capabilities in materials science students.The main purpose of a rotary kiln hydrolyser is to convert olive pits into char fated to the production of activated char. The capacity of plant is about of wet olive pit, distribution of pyrolysis products as function of the process temperature

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