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The Exploration of Application-oriented Universities "Specialized Innovation Integration" Educational Practice

-- Take the Introduction to Intelligent Manufacturing Course as an Example

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Abstract

In the context of the dual-innovation landscape, there is an immediate need to refine the training model aimed at nurturing innovative talents. This study, based on an investigation into the current state of innovation and entrepreneurship education in application-oriented universities, examines the imperative of advancing "specialized innovative integration" education. It delineates the challenges inherent in the developmental process of specialized integrated education. Following the principles of Outcomes-Based Education (OBE), the exploration and practical implementation systematically address three key dimensions: defining learning goals, designing curriculum instruction, and evaluating learning achievements. Using the course "Introduction to Intelligent Manufacturing" as a case study, the study conducts an in-depth analysis of the developmental concepts and construction plans of "specialized innovative integration" education, providing a valuable reference for the development and construction of similar courses.

Keywords

Intelligent Manufacture; "Specialized Innovation Integration"; Curriculum Ideology and Politics; OBE; Application-oriented Universities; Innovation and Entrepreneurship.

1. Introduction

Individuals with an innovative spirit are acknowledged for their exploratory and creative nature, contributing significantly to social development through valuable and inventive efforts. General Secretary Xi Jinping emphasizes cultivating a scientific spirit, fostering innovation, and promoting critical thinking. Achieving this objective involves deepening educational reforms, advancing educational equity, and enhancing overall educational quality. College students play a pivotal role in supporting the strategy of deepening mass entrepreneurship and innovation. Therefore, fostering innovation and entrepreneurship among college students is crucial. Despite the requirement in applied undergraduate education for close integration with local characteristics and a focus on cultivating students' practical abilities to nurture application-oriented talents, the anticipated impact in innovation and entrepreneurship education has yet to fully align with the country's new innovation-driven development requirements [1-3].

In colleges and universities, innovation and entrepreneurship education and professional education are interdependent, mutually reinforcing each other to establish a robust foundation for shared advancement. Professional education provides essential support to innovation and entrepreneurship education, while the latter represents the enrichment and deepening of professional education. The integration of "Specialized Innovation Integration" not only aligns with the demands of the contemporary era but also closely aligns with the pressing

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requirements of educational reform. Consequently, actively advancing the reform of professional education and innovation and entrepreneurship education has become imperative for the development of colleges and universities. The essence of this developmental trajectory lies in the organic fusion of professional knowledge transfer innovation and entrepreneurship, facilitating a profound transformation in the landscape of professional education classrooms.

2. The Present State of "Specialized Innovation Integration" in Colleges and Universities

In terms of instilling entrepreneurial awareness among college students, Western developed countries, particularly the United States, have consistently held a leading position, particularly in the realm of innovation and entrepreneurship education. The pioneering moment dates back to 1947 when Myles Mace established the first "New Enterprise Management" course at Harvard Business School, marking the inception of entrepreneurship education in American universities. In contrast, China embarked on its journey of innovation and entrepreneurship education relatively late, gaining momentum in the late 1990s when colleges and universities began delving into this field. The exploration of innovation and entrepreneurship education in Chinese higher education officially commenced in 1997 with Qinghua University hosting the inaugural "Challenge Cup" college student entrepreneurship plan competition. This event marked over two decades of development in innovation and entrepreneurship education in Chinese higher education. Scholars like Nin et al proposed the "4 combinations" training mode, utilizing the financial management major as a model, and introduced the "4 levels of step-by-step progression" for the specialization and integration of the teaching system[4]. Lin et al, focusing on accounting professional practice, demonstrated an OBE approach to integrating specialization and Innovation, constructing a practical training platform and a competition mechanism [5]. Additionally, Song et al introduced a competence matrix for specialized innovation integration in applied universities and developed a dual innovation education practice system using industrial engineering as a case study[6-7]. Combining existing research results with survey findings, it becomes apparent that several issues currently exist in specialized innovation integration education in colleges and universities[8-9]:

(1) Disconnection between bicultural education and professional education system.

The current state of innovation and entrepreneurship education in most universities involves an independent system, primarily delivering university-wide compulsory courses like "innovation and entrepreneurship fundamentals." Some institutions have established specialized innovation and entrepreneurship colleges or majors dedicated to advancing "dual-creation education" [10-11]. However, these majors often heavily rely on traditional professional training programs and education systems for student development. In the teaching of professional courses, the focus is on imparting basic professional theories and skills, with limited attention given to guiding the concept of "dual innovation," and cultivating practical abilities.

(2) Lack of complex education teachers.

Bicreative education in China is still in its early stages and faces the critical challenge of insufficient teachers. The main issue in the education field is that teachers' knowledge structures have not fully adapted to the requirements of "dual innovation" education. Some teachers lack a deep understanding of the actual operation mechanisms of enterprises and real users' needs, limiting their knowledge of market competition and enterprise profitability. This challenge hinders their ability to provide accurate guidance on entrepreneurial practices to students. Moreover, many colleges and universities tend to treat professional teachers and innovation and entrepreneurship teachers as two separate groups. Professional teachers may lack knowledge of the theoretical aspects and methods of innovation and entrepreneurship,

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while innovation and entrepreneurship teachers may have a limited understanding of the content of professional courses. The concept of organic integration between professional innovation and entrepreneurship is not clear enough. Additionally, some professional teachers may lack a deep understanding of "dual innovation" education and lack innovative and entrepreneurial thinking. This situation leads to a "two skins" phenomenon between innovation and entrepreneurship courses and professional courses, adversely affecting overall teaching effectiveness. Therefore, there is an urgent need to increase the proportion of professional teachers with innovation and entrepreneurship education abilities to better meet the requirements of dual-creation education.

(3) Insufficient integration of "Specialized Innovation Integration" education.

In recent years, there has been a growing interest in innovation and entrepreneurship education in universities, leading to a demand for diversified curricula. However, achieving synergy between innovation and entrepreneurship education and professional education remains challenging. This challenge stems from the diverse majors offered by colleges and universities, with some emphasizing basic knowledge and others focusing on industrial applications. Effectively incorporating innovation and entrepreneurship elements into the delivery of professional courses, promoting targeted innovation and entrepreneurship education, and clearly defining these directions are still areas that need further clarification. In general, most schools are in the initial stages of promoting the education reform of "Specialized Innovation Integration" Educational and the methods adopted are relatively limited. Professional-led innovation and entrepreneurship curricula and practice platforms are not fully developed, posing a constraint on realizing innovation and entrepreneurship achievements in the professional field. Therefore, there is an urgent need to enhance the innovation and entrepreneurship abilities of students in the professional field. Although some students choose to start their own businesses, their projects often have low technological content. Most innovations are limited to business models, indicating a relatively weak emphasis on scientific and technological innovation.

3. Exploring the Implementation Route of "Specialized Innovation Integration" Educational

"Specialized Innovation Integration" education integrates professional education and innovation and entrepreneurship education, aiming for innovative or entrepreneurial outcomes, aligning naturally with the concept of OBE [12-13]. OBE education places learning goals at the core, striving to achieve desired learning outcomes through meticulous planning and improvement across all aspects of the educational process. The implementation of the OBE philosophy typically involves three key steps: defining learning goals, designing instructional programs, and assessing learning outcomes. Learning objectives must align with both the theoretical educational standards of the school and the practical needs of the enterprise. Curriculum design necessitates teachers to possess a profound understanding of the course content. Assessment of learning outcomes involves the evaluation and continuous improvement of students' learning outcomes and teachers' teaching effectiveness.

(1) Establishing appropriate teaching and learning development goals. The core of the OBE teaching and learning development philosophy is outcome-oriented. The first crucial task is to set appropriate teaching cultivation objectives. In the "Introduction to Intelligent Manufacturing" course, the teaching objectives are meticulously designed to empower students to innovate and enhance the production and living environment. This is achieved by mastering concepts such as lean, automation, digitization, and intelligence in intelligent manufacturing.

(2) Course instructional design. Refine the teaching process by leveraging projects as a driving force, with a focus on achieving tangible outcomes. Organize and restructure knowledge points

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in alignment with predetermined teaching objectives, creating a mind map to enhance students' understanding of the relationships between these points. Utilizing projects as a conduit enhances the cohesion of knowledge points, validating theoretical concepts in practical contexts and elevating students' interest in learning. Emphasizing the output of results as the primary goal fosters increased self-confidence and self-control in students' learning endeavors.

(3) Improvement of teaching methods.

①Online + offline blended teaching. We leverage network tools and online resources, incorporating high-quality materials like "China University Catechism" to establish asynchronous SPOC (Small Private Online Course). Students are guided to prepare for classes through pre-class introduction plans, maximizing content absorption through textbook reading and online videos. In-class activities involve categorizing and organizing knowledge points and analyzing their flexible application in various scenarios. Mastery is achieved through post-class homework and online interactions. This hybrid teaching approach, combining online and offline methods, optimizes the advantages of online resources, utilizes fragmented time effectively, enhances teaching efficiency, and improves learning outcomes.

②Two-line linkage, combination of theory + cases. Considering the course's characteristics and its practical application to real-life situations, a substantial amount of vivid and detailed case materials are introduced along with teaching content. This approach transforms abstract principles into easily understandable concepts, fostering students' interest and expanding their horizons. For instance, in the warehousing and distribution segment, using Jingdong Asia One as an example, the operation mode of unmanned warehouses, the use of AGV trolleys, and the distribution path are explained. Additionally, multi-equipment synergy involving forklifts, AGVs, robotic arms, and handling emergency insertion orders is discussed. This integration of logistics equipment and management systems transcends the boundaries of traditional professional courses, encouraging students to approach learning and problem-solving from a technological management perspective.

③Collaborative learning in groups to increase the dimension of interaction. Teachers emphasize the central role of students in the teaching process, actively incorporating discussion-based classroom teaching. Throughout the teaching process, methods such as pop-up questions, contributions, and group messages are employed to continuously gather student feedback. This feedback, combined with the specific learning situations of the students, informs targeted adjustments to teaching strategies. Before theoretical lectures, course content is often introduced through small stories or games, encouraging students to delve into the profound theoretical connotations behind the narratives. This approach has proven to be effective in enhancing the teaching impact.

④Task-driven, hands-on teaching. The teaching approach in the task elicitation stage is project-oriented and task-driven, aiming to leverage students' independent innovation. Guided by real-world scenarios, students analyze tasks, search for information, and independently complete programs. All programs are subsequently submitted to the teacher for evaluation. This approach reinforces practical teaching components, introducing additional post-course practical assignments to engage students at various levels, fostering their interest, and improving self-learning and teamwork skills. Activities encompass purchasing spare parts, creating videos, developing practical training tutorials, and guiding students to learn through the Internet and public websites.

(4) Enhancements to assessment methods include the adoption of learning outcome-oriented grading techniques. This involves establishing multiple learning stages and employing various assessment methods to alleviate the pressure associated with a single examination, thereby enhancing students' motivation to learn across diverse aspects, as shown in Table 1.

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Table 1. Multi-dimensional goal assessment methods

Assessment program	Assessment content	Evaluation criteria	Percentage
Classroom participation	Pop-ups, contributions, QQ group speeches	Combined ranking of participation and correct answers	10%
SPOC learning	Online platform learning data, evaluation of self-learning attitude and ability	5 points for all participation, 5 points for all correct answers	10%
Classroom quizzes	Quiz participation, correct answer rate	10 points	10%
Out-of-class practice	Group work, shake video, etc.	According to the difficulty of the work, the expression of scoring	10%
Final exam	Course theory, closed-book classroom tests	Test score, 50%	50%
Post-course assignments	Number and quality of homework completed	10 points for original submissions, not off-topic	10%

4. Summary

"Specialized Innovation Integration" represents an inevitable approach to talent cultivation in contemporary college education. This paper, set against the backdrop of the development of applied colleges and universities, scrutinizes the current state and challenges of specialized and innovative fusion education. Using the Introduction to Intelligent Manufacturing course as an exemplar, it showcases the exploration of this teaching reform concerning specialization and innovation integration, addressing course objectives, teaching content design, and teaching method reform. Teaching feedback indicates that students express significant interest in this open teaching method, enabling them to freely explore within the professional context and excel in various competitions, reflecting the effectiveness of this ongoing teaching reform. "Specialized Innovation Integration" extends beyond the exploration of a single course; it signifies a shift in educational and pedagogical thinking that requires implementation throughout the entire professional training program. Specialized fusion education is an integrated innovation involving multiple disciplines and elements, and the cultivation of composite teachers is a long-term, challenging task that requires continuous promotion by applied colleges and universities.

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