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Construction and Exploration of a Micro-specialty in Intelligent Product Design Based on the Concept of Innovation and Entrepreneurship Education

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Abstract: With the burgeoning global innovation boom and the ongoing refinement of the entrepreneurial ecosystem, innovation and entrepreneurship education has gradually become an indispensable component of the higher education system. This article aims to delve deeply into and elaborate on how to seamlessly integrate the principles of innovation and entrepreneurship education into the framework and practical implementation of the intelligent product design micro-major curriculum system. The goal is to cultivate high-quality professional talents who possess innovative thinking, entrepreneurial skills, and practical operational abilities. By meticulously constructing a curriculum system that is project-driven, characterized by interdisciplinary integration, and closely aligned with industry, academia, and research, this article further refines the construction strategy for the intelligent product design micro-major, providing robust theoretical support and practical guidance for advancing related educational practices.

1. Introduction

In the era of knowledge economy, innovation has become the core driving force for social progress and economic development. In the field of innovation and entrepreneurship education, curriculum development is one of the core issues. In recent years, many domestic universities have attempted to establish and construct micro-specialties, aiming to meet the growing demand for comprehensive quality and breadth of knowledge of talents from the rapid development of modern society and the transformation and upgrading of various industries. As an emerging design field, intelligent product design integrates knowledge and skills from multiple disciplines such as computer science, mechanical engineering, and art design, with a broad development prospect and market demand. Therefore, constructing a micro-specialty curriculum for intelligent product design based on the concept of innovation and entrepreneurship education is of great significance for cultivating high-quality talents who meet the future societal needs.

2. The application of innovation and entrepreneurship education concepts in the micro specialization of smart product design

2.1 Analysis of innovation and entrepreneurship education concepts

In recent years, with the rise and development of online education, micro specialization courses have gradually become one of the research hotspots in the field of higher education. Innovation and entrepreneurship education, as an emerging educational concept and model, aims to promote the overall development of students by fostering their innovative thinking, entrepreneurial spirit, and practical abilities. Micro specialization courses, as a new form of course in the higher education curriculum system, have characteristics of strong flexibility, strong pertinence, and strong practicality. In the micro specialization course of smart product design, the concept of innovation and entrepreneurship education should run through the entire teaching process to stimulate students' innovative potential and entrepreneurial enthusiasm.

Scholars at home and abroad have conducted extensive and in-depth research on the theory and practice of innovation and entrepreneurship education, forming rich theoretical achievements and practical experience. Specifically, the concept of innovation and entrepreneurship education should include the following three aspects: First, cultivating students' innovative thinking, encouraging them to be brave in trying and daring to innovate; Second, cultivating students' entrepreneurial spirit, guiding them to establish correct entrepreneurial concepts and values; Third, cultivating students' practical abilities, improving their ability to solve practical problems through practical projects and activities.

2.2 The Status and Challenges of Micro-major Models in Applied Undergraduate Colleges

2.2.1 Issues in Course Implementation

One pressing issue concerns the low level of student participation, coupled with a lack of comprehension in innovation and entrepreneurship education, which results in diminished enthusiasm and initiative. Secondly, the challenge of interdisciplinary collaboration is significant, hindered by knowledge silos and communication barriers across disciplines, impeding the seamless progression of joint efforts. Thirdly, the depth of cooperation between industry, academia, and research remains inadequate, with an imperfect cooperation mechanism with industry, thus hindering the realization of resource sharing and complementary strengths. Lastly, the evaluation system falls short of comprehensively and accurately assessing students' learning achievements and course implementation outcomes.

2.2.2 Limitations of the Existing Curriculum System

Firstly, the relatively single course content is difficult to meet the diverse learning needs of students; Secondly, teaching methods and tools are relatively traditional and difficult to stimulate students' interest and creativity in learning; Thirdly, the curriculum system lacks flexibility and specificity, making it difficult to adapt to the learning characteristics and interests of different students; The fourth issue is that the curriculum system lacks innovation and foresight, making it difficult to keep up with the pace of industry development and changes in market demand.

2.2.3 In-depth Challenges of Integrating Innovation and Entrepreneurship Education with Micro-specialized Education

One key aspect is balancing the relationship between innovation and entrepreneurship education,

and professional education, ensuring they mutually enhance and complement each other. Secondly, constructing a scientifically sound curriculum system that caters to the dual demands of both innovation and entrepreneurship education, as well as professional education, is crucial. Lastly, establishing effective incentive mechanisms and evaluation systems to ignite students' learning enthusiasm and creativity, thereby fostering the profound development of innovation and entrepreneurship education, is imperative.

2.3 Integrating the concept of innovation and entrepreneurship into micro-specialized curriculum design principles

When integrating the concept of innovation and entrepreneurship education into the design of micro-specialized courses in intelligent product design, the following principles should be followed: First is the goal-oriented principle, which means clarifying the course objectives and designing the course content around these objectives; second is the project-driven principle, which involves carrying out teaching activities using real projects as carriers; third is the interdisciplinary integration principle, which means breaking down disciplinary barriers to promote the cross-integration of knowledge from multiple disciplines; fourth is the industry-academia-research cooperation principle, which involves strengthening cooperation and exchanges with the industry to achieve resource sharing and complementary advantages.

3. Construction Ideas for Micro specialization Curriculum in Smart Product Design

Based on the aforementioned principles and comprehensive analysis, this article introduces a construction framework for an intelligent product design micro-professional course system, rooted in the philosophy of innovation and entrepreneurship education. Firstly, it underscores the importance of defining clear course objectives and designing the curriculum content in alignment with these objectives. Secondly, it advocates the establishment of a project-driven teaching paradigm, encouraging students to engage in hands-on projects that facilitate deeper learning and practical application. Additionally, it emphasizes the reinforcement of interdisciplinary integration, fostering the blending of multifaceted knowledge domains. Lastly, it underscores the significance of strengthening collaboration and dialogue with the industry, ensuring a seamless integration between industry, academia, and research endeavors.

3.1 Curriculum Goal Setting

Based on the demands of innovative and entrepreneurial education concepts, as well as the unique characteristics of the intelligent product design field, the following course objectives have been established: firstly, to foster students' innovative thinking and entrepreneurial mindset; secondly, to enable students to grasp the fundamental principles and methodologies of intelligent product design; thirdly, to empower students with the proficiency to address real-world problems and develop strong teamwork skills;and lastly, to impart an understanding of industry trends and market demands, thereby laying a solid foundation for future innovation and entrepreneurial endeavors.

3.2 Curriculum Content Planning

In accordance with the essence of innovation and entrepreneurship education principles and the unique aspects of the realm of intelligent product design, the subsequent course objectives have been delineated: firstly, to instill in students an innovative mindset and an entrepreneurial attitude;

secondly, to ensure mastery of the fundamental principles and techniques of intelligent product design; thirdly, to equip them with the capability to tackle practical challenges and develop teamwork abilities; and lastly, to comprehend the evolving trends of the industry and market demands, thereby establishing a strong foundation for future endeavors in innovation and entrepreneurship endeavors.

3.3 Teaching Methods and Approaches

For enhancing the effectiveness of the curriculum, this article advocates the utilization of various instructional methodologies and resources. Firstly, the hybrid learning paradigm, which integrates online lectures with face-to-face discussions, fosters student engagement and encourages active learning. Secondly, the utilization of case studies enables students to apply theoretical knowledge to practical scenarios, thereby enhancing comprehension. Thirdly, the adoption of project-based learning promotes hands-on experience and teamwork skills among students. Lastly, the partnership between academia and industry offers students the opportunity to engage in real-world projects, nurturing their creativity, entrepreneurial spirit, and market awareness.

3.4 Evaluation System Construction

To comprehensively assess students' learning outcomes and the effectiveness of course implementation, this article establishes a multifaceted evaluation framework. Firstly, process evaluation meticulously examines students' learning attitudes and endeavors through their classroom participation, homework completion, and other relevant aspects. Secondly, achievement evaluation rigorously evaluates students' learning achievements and innovative capabilities, drawing insights from their project works, design reports, and other accomplishments. Additionally, the evaluation of innovation and entrepreneurship ability delves into students' entrepreneurial potential and market competitiveness, considering factors like entrepreneurship plans and business model exploration. These diverse evaluation methods mutually reinforce and validate each other, collectively constituting a comprehensive and holistic evaluation system.

4. Practice and Application of Micro-specialization Model in Smart Product Design

4.1 Curriculum Team Building

The curriculum development squad comprises seasoned professional educators from the institution, prominent technical pillars and managerial prodigies from the forefront of industry, alongside administrative and technical specialists from the learning platform, among others. The professional teachers within the school collaborate intimately with enterprise technical experts and managerial talents to meticulously devise and formulate the essential professional curriculum framework, grounded in the genuine requirements of career progression. Additionally, the front-line elites of the enterprise actively engage in imparting educational and internship guidance to students, thereby guaranteeing a seamless alignment between course content and practical work settings[1].

4.2 Construction of the Smart Product Design Micro-specialization Curriculum System

Intelligent product design is a multifaceted, interdisciplinary realm that seamlessly blends art and science. It encompasses diverse fields such as aesthetics, art, mechanical engineering, materials science, human-computer interaction, and service design, all aimed at nurturing versatile individuals with exceptional design application skills. Within the micro-major framework, a pivotal challenge

lies in augmenting cross-disciplinary integration, fostering creativity and entrepreneurial zeal among design students, broadening their perspectives through structured and efficient coursework and practical experiences, and swiftly enhancing their professional core competencies to maximize the effectiveness of interdisciplinary integration. This is a crucial issue demanding urgent attention in the reform and innovation endeavors pertaining to intelligent product design courses.

The Intelligent Product Design Micro-major program offers a comprehensive curriculum consisting of 6 specialized courses, totaling 11 credits and spanning 176 classroom hours. This includes two foundational courses for micro-majors: Introduction to Intelligent Product Design and Computer Aided Design. Additionally, there are four core courses tailored for the micro-major: Product Form Design, Cultural and Creative Product Design, Product Design Innovation and Development, and Intelligent Product Interaction Design. The micro-major program spans 2 years, structured into three distinct learning phases, with each phase lasting 4 months and encompassing two specialized courses. The detailed course offerings for the Intelligent Product Design Micro-major are outlined in Table 1.

Table 1: Micro Specialty Curriculum for Intelligent Product Design

Number sequence	Course Name	Credit	Total hours of study	Start of classes Semester
1	Introduction to Smart Product Design	1	16	1
2	Computer-Aided Design	3	48	2
3	Product form design	1	16	3
4	Cultural and Creative Product Design	2	32	3
5	Product Design Innovation and Development	2	32	4
6	Smart Product Interaction Design	2	32	4

4.2.1 Introduction to Intelligent Product Design

Based on a comprehensive examination of the evolutionary journey of intelligent technology, this course offers a meticulous exposition on its essence, fundamental theories, and pivotal methodologies. It underscores a profound understanding facilitated by case studies and hands-on design exercises. The curriculum boasts a broad and profound scope, embracing the latest advancements in intelligent manufacturing and products, the technical backbone of intelligent offerings, the harmonious fusion of intelligent products and creative thought, innovative design strategies for intelligent products, the intricate decision-making process underpinning their development, frontier explorations in intelligent product capabilities and interactive experiences, the profound integration of intelligent products with artificial intelligence, insightful analyses of exemplary intelligent product cases, and comprehensive guidance on the practical development of intelligent products.

4.2.2 Computer-Aided Design

By studying this course, students will master the operational skills of Photoshop for graphic design and Rhino3D NURBS Rhinoceros software for 3D modeling. They will gain an in-depth understanding of industrial product 3D reverse modeling design methods and related application technologies. Additionally, the course aims to cultivate students' abilities in applying 3D modeling software, enabling them to independently complete 3D product design and stimulate their innovative thinking and practical abilities.

4.2.3 Product Form Design

By thoroughly examining a plethora of product design examples spanning both historical and contemporary eras, and traversing diverse geographical regions worldwide, this course endeavors to guide individuals in delving into the fundamental principles underlying the diverse forms of product designs. It fosters a profound comprehension of how pivotal elements like functionality, structure, material choice, and cultural nuances profoundly impact the evolution of product shapes. Additionally, it promotes the adaptable employment of sophisticated design methodologies, igniting innovative thoughts, and ultimately nurturing creativity, heightened sensitivity, and exceptional form design articulation.

4.2.4 Cultural and Creative Product Design

"Cultural and Creative Concepts" serve as the longitude, while "Cultural and Creative Design Directions" function as the latitude, guiding this course's objective to impart a profound understanding of the essence and far-reaching influence of cultural and creative product design. It accomplishes this by meticulously elucidating the core principles and innovative methodologies inherent in this field. By delving into meticulously selected cases of cultural and creative products, students will develop a heightened admiration for their aesthetic appeal and attain proficiency in a myriad of comprehensive design competencies, encompassing innovative design techniques, product development and manufacturing processes, brand promotion strategies, and management principles. Furthermore, the course incorporates a hands-on component, fostering students' abilities to apply cultural research methodologies in topic exploration, ultimately enabling them to autonomously create an integrated and exquisite portfolio of cultural and creative product designs, thereby significantly augmenting their practical proficiencies and holistic literacy[2].

4.2.5 Product Design Innovation and Development

Through specialized training in intelligent product design, students' innovation and practical abilities are cultivated. Emphasis is placed on the combination of creative thinking and design practice, as well as the interaction between hands-on work and innovation. Students can systematically learn the broad theoretical and practical knowledge of the product design field; possess the basic capabilities for design innovation and development research, including artistic cultivation, theoretical analysis, design expression, software application, etc.; the focus is on practical design topics for enterprises, and students are encouraged and guided to participate in various design competitions and social practice activities.

4.2.6 Smart Product Interaction Design

This course aims to enable students to deeply understand the theoretical knowledge of smart product interaction design. The course is centered around Arduino programming software, using a variety of interactive sensing devices to guide students in designing and creating smart interactive products. During the learning process, students are required to work in groups, jointly learning to master the operational mechanisms and programming principles of Arduino, and to complete the design and implementation of plans through teamwork.

4.3 Design of Teaching Methods for the Microspecialty in Intelligent Product Design

4.3.1 Project-Based Teaching Model Based on the Integration of Online and Offline and CDIO Concept

The micro major of intelligent product design's teaching method design emphasizes the integration of theory and practice, the incorporation of hands-on projects, fostering self-directed learning capabilities, and executing diversified assessment methodologies. The teaching team, cognizant of the discipline's professional nuances and societal demands, has devised a project-centric teaching paradigm rooted in online-offline integration and the CDIO framework, tailored for applied universities. This approach modularizes project-based lesson plans, fosters an open classroom environment with the invaluable input of industry mentors, and tailors specific instructional blueprints for each class[3].

Key advancements will be achieved in addressing three pivotal challenges: enhancing the efficacy of students' extracurricular learning endeavors, meticulously managing the ideological and political implications of project selection, and ensuring equitable collaboration within groups. These strategic interventions aim to furnish students with a holistic and multi-faceted learning journey, nurturing them into intelligent product design professionals imbued with an innovative mindset and robust practical skills.

Firstly, the curriculum will revolve around the core knowledge points of intelligent product design, including but not limited to the basics of artificial intelligence, principles of interaction design, user experience research, smart hardware technology, data visualization and analysis, etc. Each course will employ various teaching methods such as case studies, group discussions, and project-driven approaches to ensure that students can comprehensively and systematically master the relevant knowledge.

Secondly, to bolster students' practical competencies, we will introduce a plethora of hands-on projects. These projects emulate genuine work environments, empowering students to hone their innovative thinking, teamwork proficiency, and problem-solving capabilities as they tackle real-world issues. Additionally, we will engage industry veterans and corporate mentors in our instructional endeavors, offering students market-focused guidance and insights.

Furthermore, we will also focus on cultivating students' independent learning abilities. By providing online learning resources, establishing learning communities, and organizing academic exchange activities, we aim to stimulate students' interest and motivation in learning, enabling them to actively explore new knowledge, technologies, and methods.

4.3.2 Information-based Teaching Management Innovation

The Intelligent Product Design major is accessible to all university students, regardless of their original majors. It adopts a blended learning model that combines online and offline teaching methods, posing significant management challenges due to its complexity. The teaching team will devise a comprehensive student management system, leveraging the educational administration system and internet-based intelligent teaching platforms. This system will enable online check-ins, assignment submission and collection, video viewing monitoring, discussions, interactions, and other classroom activities.

Moreover, we will thoroughly supervise students' online learning discipline and effectiveness, promptly access their learning data, and promptly engage with students who demonstrate unsatisfactory learning outcomes to offer assistance and resolve issues. By fostering real-time interactions on online teaching platforms, QQ groups, and WeChat groups, we collectively ensure the seamless progression of online teaching[4].

4.3.3 Student Self-Management

Most micro-professional courses are conducted in the form of collaborative teamwork groups, fostering mutual supervision among students. The final grade assessment incorporates six student-centric evaluation methods: student lecture evaluation, student-as-lecturer evaluation, team leader evaluation, inter-group evaluation, intra-group evaluation, and voting evaluation. This approach encourages students to enhance their learning enthusiasm and participation, thereby promoting self-management among peers.

4.4 Design of Assessment Methods for the Micro specialization in Intelligent Product Design

To precisely gauge students' learning achievements, micro majors have devised a holistic assessment framework grounded in the Outcome Based Education (OBE) philosophy. This framework intimately aligns with course objectives, encompassing a multifaceted evaluation of knowledge, skills, literacy, and ideological-political competencies. It places particular emphasis on assessing pivotal abilities like project-based learning, team collaboration, and innovative thinking. Throughout the course execution, we've embraced ten diverse assessment methods, including online quizzes, essay writing, and presentations, to guarantee the comprehensiveness and rigor of the evaluation process.

A multifaceted scoring guideline, embracing six dimensions such as workload, thoroughness, creativity, functional ease-of-use, visual appeal, ideological and political stance, along with feasibility, has been crafted for the project presentation phase to evaluate students' project outcomes in a comprehensive manner. Specifically, the ideological and political evaluation segment delves deeper into five crucial aspects: embracing traditional culture, advocating for environmental conservation, demonstrating humanistic values, engaging in ethical contemplation about smart devices, and nurturing a vibrant campus culture, all geared towards enhancing students' all-round development [5].

In the grading process, six key "student-centered" assessment techniques are utilized: peer evaluation (where students appraise each other), student presentations coupled with teacher feedback (where students present and educators assess), team leader scoring, cross-team evaluation, intra-team evaluation, and merit-based voting. This innovative approach not only diversifies the pool of evaluators but also augments the formative, procedural, and multifaceted nature of assessment, enhancing its flexibility and range. By executing this thorough and meticulous evaluation framework, we empower students with meticulous and unbiased feedback, fostering a more pertinent and productive guidance experience.

5. Conclusion

This article is based on a broad perspective of innovation and entrepreneurship, and provides a detailed and in-depth exploration of the construction strategy and specific implementation path of the micro professional course system for intelligent product design. Micro majors, as an emerging and dynamic talent cultivation model, are unique in that they cleverly integrate professional knowledge, vocational skills, and enterprise development needs, and have become a key factor for applied undergraduate colleges in cultivating high-quality talents.

Faced with the ever-changing social demands and constantly changing industry trends, applied undergraduate colleges should be brave enough to take responsibility, actively reform the constraints of traditional teaching, and actively embrace the innovative model of micro majors. By accurately aligning with market demand and combining the school's own characteristics and advantages, we have constructed a smart product design micro professional curriculum system that

meets the requirements of the times and has unique features, thereby cultivating outstanding talents who can quickly adapt to and lead social development.

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3) Shandong Province, Tai'an City 2024 Educational Science Planning Project: Research on the Development and Utilization of Teaching Resources of Red Revolutionary Traditional Culture in General Education Courses at Universities from the Perspective of "First Class Political Responsibility System" (TJK202409ZX144).

References

[1] Sun, Yanhua, and Jing Chen. "Research and Application of Web Front-end Development Micro-Speciality Curriculum System in Higher Vocational Colleges." J. Architecture. 4 (2021): 56-60.

[2] Lessard, Lysanne, et al. "Expanding the nature and scope of requirements for service systems through Service-Dominant Logic: the case of a telemonitoring service." Requirements Engineering 25.3 (2020): 273-293.

[3] Engstrom, David Freeman, and Daniel E. Ho. "Algorithmic accountability in the administrative state." Yale J. on Reg. 37 (2020): 800.

[4] Jiang, Jie, et al. "Construction of a New Engineering of Marine Technology based on the Approach of" Morality, Teaching, Learning, Research and Industry":--Taking Oceanography Course as an Example." Journal of Education and Educational Research 4.3 (2023): 173-177.

[5] Xing J, Yang X, Cao C, et al. Construction of Beidou Space Time Technology Application Micromajor and Practice of Characteristic New Engineering Education[C]//China Satellite Navigation Conference. Singapore: Springer Nature Singapore, 2023: 242-251.