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THE CONSTRUCTION OF GENERAL EDUCATION COURSES OF INNOVATION AND ENTREPRENEURSHIP BASED ON TWO TEACHERS, THREE STAGES, FOUR STEPS AND FIVE EVALUATIONS

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Abstract: This article outlines a progressive approach to cultivating innovative and entrepreneurial talents, focusing on stimulating interest, discovering potential, forming teams, becoming key members, and ultimately becoming core members. It also integrates courses such as college student employment guidance, career planning, and policies to offer general courses in innovation and entrepreneurship, thereby enriching students 'foundational skills in these areas. The article addresses three core issues in the development of these general courses: the disconnection between course content and professional scenarios, insufficient depth in teaching, and a monolithic evaluation system. To tackle these challenges, the article proposes a model for constructing general courses in innovation and entrepreneurship education, known as' dual-teacher, three-stages, four-steps, five-evaluations. 'This model involves school-enterprise collaboration in developing teaching resources, dual-teacher co-teaching to create a professional atmosphere, three-stages and four-steps classroom instruction, and five-evaluations to enhance educational outcomes. By optimizing the resources for general courses in innovation and entrepreneurship, this approach enhances students' practical skills, supports the reform of the 'three teachings', and achieves a talent cultivation model for innovation and entrepreneurship that is aligned with professional scenarios.
Keywords: Double innovation general education course construction mode; Phased course setting; Course evaluation system; School-enterprise "double teacher" education

1 INTRODUCTION

Drawing on the experiences from competitions such as the China International College Students Innovation Competition, the Shanghai Vocational College Students Innovation and Creativity Competition, the National College Students Market Research and Analysis Competition, and the National Digital and Intelligent Enterprise Operation Simulation Competition, we have introduced a general course on innovation and entrepreneurship. This course integrates core competency courses with professional courses, creating a comprehensive innovation and entrepreneurship education chain that covers 'inspiration, creativity, team building, and entrepreneurial practice'. By integrating professional courses with innovation and entrepreneurship education, we introduce relevant content and resources into the curriculum to create a system that combines professional competence courses with innovation and entrepreneurship content, thus forming an integrated general course system. This approach aims to not only equip students with core competencies in various majors but also enable them to apply their knowledge in real-world scenarios. Therefore, the major places significant emphasis on cultivating innovation and entrepreneurship skills, focusing on three key areas: how to develop application-oriented general courses, how to build a teaching model that fosters comprehensive skills, and how to create a classroom atmosphere that aligns with professional scenarios. Through collaboration with enterprises and joint training, students will become proficient in mastering core competencies, familiar with application scenarios, and well-versed in the professional workplace environment, thereby forming a comprehensive set of skills that integrate theory, practice, and professional competence[1-2].

How can we develop a general course on innovation and entrepreneurship tailored to specific application scenarios? The scope of innovation and entrepreneurship education is broad, spanning various industries with significant overlap. However, there is currently no unified model for its development. Existing courses lack focus on the key scenarios of Shanghai as an 'International Digital City', making it difficult for students to establish a clear connection between technology, scenarios, and job positions. There is an urgent need to align with the key scenarios that drive Shanghai's economic development, leveraging the unique features of Shanghai's innovation and entrepreneurship education, to create courses that are directly applicable to real-world scenarios. This article aims to enhance the teaching capabilities and qualities of existing professional course instructors in innovation and entrepreneurship, encouraging them to actively integrate cutting-edge technological advancements, the latest research findings, and practical enterprise experiences into their professional courses. This will continuously improve the integration of professional and innovation and entrepreneurship education[3-4].

How can we develop a curriculum model that fosters comprehensive skills? The core courses and content of the IoT integrated high school program are characterized by their strong theoretical and comprehensive nature. Therefore, all core courses at the Shanghai Advanced Technical School's IoT integrated high school program have achieved 100%

integration of theory and practice, with nearly 50% of the course content dedicated to practical training. However, due to a shortage of specialized training and operational instructors, it is challenging to further increase the proportion of practical content in the curriculum structure, leading to a bottleneck in course optimization. This situation makes it difficult to overcome the challenge of' knowledge instruction as the main focus, fragmented skill training. 'There is an urgent need to collaborate with partner enterprises to jointly enhance students' knowledge, skills, and overall qualities.
How can we create a classroom atmosphere that aligns with professional settings? Students will eventually enter the workforce and become professionals. To prepare students for their future careers, it is essential to replicate real-world workplace processes, such as project management, task execution, and outcome evaluation, by integrating these elements into the classroom through collaborative efforts between schools and enterprises. For instance, when students start working, they often interact most with supervisors, mentors, and colleagues. Transforming these workplace roles into educational roles is a critical aspect of professional development[5-6].

2 THE CONSTRUCTION METHOD OF GENERAL EDUCATION COURSES FOR INNOVATION AND ENTREPRENEURSHIP BASED ON TWO TEACHERS, THREE STAGES, FOUR STEPS AND FIVE EVALUATIONS

2.1 Model Refinement

Based on the characteristics of courses in innovation and entrepreneurship education, schools and enterprises have collaborated to develop a structured model for general education courses in this field. This model features dual-subject entities, three-stage capability progression, four-step standard implementation, and five-dimensional value-added evaluation. Together, they have developed a series of replicable paradigms for engineering courses based on real-world scenarios, industrial equipment, and actual projects, which are suitable for both innovation and entrepreneurship courses and cross-scenario skill development

2.2 Specific Practices

2.2.1 Joint construction between schools and enterprises to create teaching resources

Focusing on the 'life' scenarios in Shanghai's' International Digital Capital 'development, the team behind the innovation and entrepreneurship (I&E) course has collaborated with companies operating in Shanghai's communities, supermarkets, and municipal sectors. They have established various scenario-based training labs, incorporating real-world cases from these enterprises. This initiative aims to create practical learning environments and teaching resources tailored to specific application scenarios within the I&E general education courses. The team regularly invites industry experts and I&E service providers to campus as corporate mentors, attracting a wide range of talented individuals from different sectors to participate in 'Entrepreneur on Campus' activities. These activities introduce students to corporate networks, entrepreneurial experiences, and provide insights into entrepreneurship policies, corporate projects, industry news, innovation experiences, and practical opportunities.

2.2.2 Dual teachers in the same hall to create a professional atmosphere

Based on the characteristics of teaching in schools and enterprises, both parties focus on their respective strengths to conduct teaching activities. Schools, through internal training and external recruitment, dispatch 'dual-qualified' professional teachers with vocational skill certificates and introduce entrepreneurship and innovation guidance teachers from enterprises, forming a team of 'professional teachers + enterprise-introduced entrepreneurship and innovation guidance teachers' to build knowledge systems and teach basic skills. Enterprises, on the other hand, send technical supervisors, senior engineers, or experienced mentors who students are most likely to encounter when they first enter the workplace, to design scenario-based tasks and impart job norms. In the classroom, these real-world professionals create a professional atmosphere by assuming real roles, helping students transition from 'students' to 'professionals'.
At the same time, we will closely track professional graduates and explore outstanding alumni in the field of enterprise work, innovation and entrepreneurship. They will return to school with "projects" and stories to serve "senior students", share their own career choices and development, entrepreneurial history and stories, attract outstanding students to participate in mature entrepreneurial projects, and form a benchmark effect among professional students.

2.3 Design the Course Teaching in Three Steps and Four Steps

Based on BOPPPS model, the construction mode of professional training courses for Internet of Things is constructed, and the courses are divided into three stages and four teaching steps.

2.3.1 Stage 1: Knowledge learning driven by problems

This stage includes knowledge learning, which corresponds to the four elements of import, target, pre-test and participation in BOPPPS model.
Step one: Knowledge learning is primarily the responsibility of professional teachers. They introduce situational questions related to the task, guiding students to clarify teaching objectives, conduct pre-reading tests, and complete knowledge instruction relevant to the task. Situational questions serve as the introduction, presenting real-world problems to create a specific scenario that sparks students' curiosity. Learning objectives are set to reflect the requirements and standards for this task, distinguishing them from those in the skill practice phase. Pre-reading tests, which involve watching micro-lesson videos and completing pre-class assessments, help students review the previous

course material and their existing knowledge. Knowledge instruction, through methods such as storytelling, discussions, and Q&A sessions, covers new knowledge, preparing students for skill learning and deepening their skills.

2.3.2 Stage 2: Skill practice driven by tasks

This stage includes skill learning and skill deepening, corresponding to the participating elements of the BOPPPS model. The second step of skill learning is primarily managed by teachers from the Innovation and Entrepreneurship program. Through teacher demonstrations and student operations, students are guided to 'follow the example' in completing core tasks. This step not only encourages students to experiment with new innovations but also emphasizes their understanding and application of 'new knowledge' acquired during the learning phase, helping them build a framework of knowledge and skills related to the current innovation task.

The third step, which deepens skills, is primarily managed by the company. The technical supervisor uses methods such as project kick-off meetings and briefings to clearly outline the work objectives for students. Senior engineers, serving as mentors, provide guidance and support to students in completing innovative tasks in groups. This step requires students to integrate the new knowledge and skills gained during the knowledge and skill learning phases, while also reviewing their previous knowledge. By integrating both new and old knowledge and skills into a cohesive capability structure, this process aims to expand and enhance students' innovation capabilities.

2.3.3 Stage 3: quality improvement in flipped classroom

This stage includes task reporting, involving two elements of post-test and summary in BOPPPS model.

The fourth step involves the task presentation, primarily led by the company's technical director, conducted in a flipped classroom format, such as a roadshow or Q&A session. Students are divided into groups and take turns to present their work progress on the tasks assigned, following the presentation format provided by the technical director. Four teachers form the Q&A panel, asking questions to the presenting students in turn, and the technical director provides feedback and summaries for each group. The group Q&A session serves as a post-test to assess students' mastery of knowledge and skills; the technical director's feedback and summary serve as a summary, providing an opportunity for both teachers and students to reflect together, enhancing their engagement in subsequent teaching and learning activities.

2.4 Five Evaluations to Improve the Effectiveness of Education

The Overall Plan for Deepening the Reform of Education Evaluation in the New Era, issued by the CPC Central Committee and The State Council, points out that we should improve the result evaluation, strengthen the process evaluation, explore the value-added evaluation, and improve the comprehensive evaluation. In professional innovation and entrepreneurship teaching, the main implementation is the process evaluation, value-added evaluation and result evaluation.

Procedural evaluation occurs during the stages of knowledge acquisition and skill practice. The first evaluation, which takes place in the first step of knowledge acquisition, primarily assesses students 'mastery of the material. This step utilizes the evaluation functions of digital teaching platforms to integrate self-assessment, peer assessment, machine assessment, and teacher assessment. The second evaluation, which occurs in the second step of skill practice, focuses on evaluating students' initial and basic skill application. Since this step does not involve group work, self-assessment and teacher assessment are primarily used. The third evaluation, which takes place in the third step of skill practice, assesses students' ability to apply their learned skills in practical scenarios. This step, involving group work and team collaboration, includes self-assessment, peer assessment, and teacher assessment.

The skill deepening phase of the dual-ability practice differs from the previous steps in that it includes a value-added evaluation, marking the fourth evaluation. This evaluation primarily assesses students 'application of' old knowledge 'and skills related to the current task, based on the content covered in the preceding lessons and courses. It evaluates students' skill growth and changes, using self-assessment, peer assessment, and teacher assessment. Considering the impact of the Ebbinghaus forgetting curve on learning outcomes and the fact that skill acquisition typically relies on deliberate practice, we intentionally incorporated students' previous learning content into the practical tasks in this step. This allows students to repeat the skills they have practiced before, enhancing their proficiency and encouraging them to apply their knowledge and skills comprehensively in practice.

The result evaluation, that is, the fifth evaluation occurs in the quality improvement stage and the task reporting step. It mainly examines students' mastery of the three-dimensional learning objectives of knowledge, skills and literacy of this innovation and entrepreneurship course through the report on the completion of work tasks, including the application of self-evaluation, mutual evaluation and teacher evaluation.

At the same time, as innovation and entrepreneurship capabilities are a comprehensive integration of various abilities, they are based on knowledge and skills but surpass them in terms of behavioral standards. This means that innovation and entrepreneurship capabilities are more explicitly expressed through behavior, making it more appropriate to evaluate these qualities alongside their practical application. Therefore, this teaching method for innovation and entrepreneurship courses primarily focuses on evaluating professional qualities and innovation and entrepreneurship capabilities during the skill deepening phase of practice and the task reporting phase of quality enhancement, see Table 1.

Table 1 Evaluation Summary

stage	step	appraise type	appraise content	appraise main body

Knowledge learning	Knowledge learning		knowledge	Self-evaluation, peer evaluation, machine evaluation and teacher evaluation
	skill learning	Procedural	technical ability	Self-evaluation, teacher evaluation
Skill practice	Skills deepened		Skills, literacy	Self-evaluation, peer evaluation and teacher evaluation
		Value-added	Knowledge, skills	Self-evaluation, peer evaluation and teacher evaluation
Quality improvement	Task report	Results-oriented	Knowledge, skills and literacy	Self-evaluation, peer evaluation and teacher evaluation

3 THE ACHIEVEMENTS AND EFFECTS OF THE RESEARCH ON THE CONSTRUCTION OF GENERAL EDUCATION COURSES FOR INNOVATION AND ENTREPRENEURSHIP BASED ON DUAL TEACHERS, THREE STAGES, FOUR STEPS AND FIVE EVALUATIONS

The first step is to upgrade the course resources. Through collaboration between schools and enterprises, a three-tier competition selection and cultivation mechanism has been established, covering class training, major selection, and competition participation. The school and enterprise jointly established the 'Double Innovation Scholarship' to provide angel funds for students 'innovative proposals. Each year, effective innovation and entrepreneurship projects are collected, and a project-demand database is created. Project matchmaking meetings are held, inviting investment institutions and industry associations to participate in the evaluation process, which promotes student entrepreneurial projects and provides strong support for course teaching. By converting real enterprise innovation cases into professional teaching resources, a progressive course chain has been formed, including' Double Innovation Foundation Course ", Double Innovation Core Course ', and' Double Innovation Comprehensive Project Course '. This meets the needs for progressive practical teaching arrangements across semesters. In the first semester, professional teachers are responsible for teaching the basics of double innovation and cultivating basic innovation and entrepreneurship skills. In the second semester, enterprise mentors and professional teachers lead students in a 4-week project-based teaching, completing the' dual-teacher three-stages four-steps five-evaluations' model. In the third semester, students independently enter enterprises for internships, with professional teachers responsible for connecting with enterprises and related double innovation work. In the fourth semester, the summary phase is entered, further enhancing comprehensive and application capabilities in double innovation. In the fifth semester, practical training courses resume to enhance overall application development skills. In the sixth semester, students complete the comprehensive design, development, implementation, and presentation of their projects, completing their graduation design.

Second, to enhance students 'practical skills in innovation and entrepreneurship education. This involves strengthening the basic qualities and comprehensive application abilities of students in entrepreneurship education. Through completing projects, students learn knowledge, apply skills, and gain hands-on experience. The curriculum includes extensive case studies and practical analyses, featuring numerous successful and failed cases of innovation and entrepreneurship. These cases guide students to analyze, discuss, and distill valuable lessons. Practical skill training is provided, including design thinking, business model canvas, lean startup, prototyping, pitch techniques, intellectual property protection, and financial basics. Additionally, the curriculum integrates interdisciplinary knowledge, encouraging the integration of technology, business, design, and humanities into projects to foster students' ability to solve problems comprehensively.

The third aspect is the practical application of radiating curriculum reform. By accumulating and refining the 'dual-teacher, three-stages, four-steps, five-evaluations' model for entrepreneurship and innovation education in general courses, this article extends the experience of integrating industry and education and fostering suitable talents through school-enterprise cooperation to the research on entrepreneurship and innovation education courses in various majors at vocational colleges. It encourages students to venture beyond the campus, engaging with communities, industrial parks, and rural areas to identify real social needs and market challenges, and to propose solutions. The focus is not only on the final outcomes, such as business plans, awards, and company registrations, but also on the students' performance during the project process, including their problem-solving skills, teamwork, iterative improvement, stress management, and learning capabilities.

4 THE EXPERIENCE SUMMARY OF THE CONSTRUCTION OF GENERAL EDUCATION COURSES FOR INNOVATION AND ENTREPRENEURSHIP BASED ON TWO TEACHERS, THREE STAGES, FOUR STEPS AND FIVE EVALUATIONS

4.1 “Theory, Practice and Nature” are Integrated, and the Teaching Content is Complex

The general education curriculum for innovation and entrepreneurship is structured around professional scenarios, guided by practical work tasks. It aims to achieve three-dimensional teaching goals: theoretical knowledge, practical skills, and professional qualities, through three stages of learning: knowledge acquisition, skill practice, and quality enhancement. Supported by school-enterprise collaboration, this model leverages the strengths of professional teachers in teaching and enterprise employees in technical expertise. Through alternating teaching methods, it ensures that knowledge is imparted in context, skills are trained according to standards, and qualities are developed through practical carriers, thus achieving a comprehensive cultivation of innovation and entrepreneurship capabilities that integrate theory,

practice, and quality.

4.2 “Learning, Practice and Evaluation” is Progressive, and Teaching Subjects are Diversified

In response to the needs of courses and teaching, four full-time and part-time teachers from both schools and enterprises have been selected to participate in the dual innovation education project. This collaboration aims to leverage their unique strengths and advantages, promoting multidimensional learning, practice, and evaluation, as well as diversifying the teaching subjects. Full-time professional teachers, who typically enter the school directly after graduating from university, are familiar with teaching but lack experience in innovation and entrepreneurship in enterprises and institutions. Therefore, they are assigned to knowledge-based teaching activities. The number of full-time enterprise teachers is limited, but their teaching abilities and technical skills are relatively balanced, making them suitable for innovative teaching activities. Based on the actual situation, full-time professional teachers and full-time enterprise teachers can also share responsibilities, covering both knowledge and dual innovation skills. Part-time enterprise teachers, while familiar with the dual innovation skills in their field, lack teaching experience at schools and have relatively limited teaching methods and skills. Thus, they can primarily focus on task assignment, acceptance, and skill guidance. By designing a four-step teaching process, the learning (knowledge construction), practice (skill solidification), and evaluation (ability diagnosis) are integrated into each part of the course. A digital platform is utilized to achieve seamless data integration for 'teaching-learning-evaluation', enabling real-time optimization of teaching strategies.

4.3 “School-Enterprise-Student” Cooperation, Teaching Activities are Contextualized

In the dual innovation education, each school-enterprise collaboration starts with a real-world scenario, immersing students in training, work, and acceptance processes that closely resemble those of industry enterprises. This setup simulates the learning and innovation environment of employees and professionals. During practical teaching, schools and enterprises provide contextual backgrounds and tasks, allowing students to engage in learning as if they were real employees. This approach makes the teaching environment more realistic, ensuring that the three-dimensional goals of knowledge, skills, and literacy are integrated throughout the teaching and learning process. In the general courses of dual innovation education, the entire process, from course introduction to outcome acceptance, is designed to simulate a professional workplace. Students participate in projects as 'quasi-employees', while the teacher team acts as 'technical supervisors and mentors'. This setup creates an immersive learning environment, helping students adapt more quickly from being 'students' to becoming 'professionals'.

5 PROMOTION AND APPLICATION OF THE CONSTRUCTION METHOD OF GENERAL EDUCATION COURSES FOR INNOVATION AND ENTREPRENEURSHIP BASED ON TWO TEACHERS, THREE STAGES, FOUR STEPS AND FIVE EVALUATIONS

Scope of application: This construction mode of general education course for innovation and entrepreneurship is suitable for the courses of all majors in higher vocational colleges.
Application scenario: This model for the construction of general education courses on innovation and entrepreneurship is designed for general education courses equipped with digital teaching platforms and resources, including foundational courses in innovation and entrepreneurship, practical courses, and courses aimed at enhancing comprehensive skills in innovation and entrepreneurship. The evaluation scheme can also be independently applied to various general education courses on innovation and entrepreneurship.
Note: This dual innovation education course model requires a professional team of full-time and part-time teachers, including 1-2 full-time teachers responsible for theoretical and practical training, and 2 part-time teachers, such as technical supervisors and senior engineers. The general education course model for this dual innovation education can be tailored to the characteristics of the professional courses and the actual faculty situation, using either step one and two or step one, two, and three[7-8].

6 DISCUSSION AND CONCLUSION

The proposed "dual-teacher, three-stages, four-steps, five-evaluations" model for constructing general education courses in innovation and entrepreneurship (I&E) addresses critical gaps in traditional I&E education by integrating school-enterprise collaboration, scenario-based learning, and multidimensional evaluation. This model bridges the disconnect between course content and professional scenarios, enhances teaching depth, and diversifies evaluation systems, fostering students’ practical skills and entrepreneurial mindset.Key achievements include: (1) Resource optimization, where school-enterprise partnerships transform real-world cases into progressive course chains (e.g., foundational, core, and project-based courses); (2) Skill enhancement, as students gain hands-on experience through interdisciplinary projects, case analyses, and competitions; and (3) Curriculum reform, with the model’s scalability across vocational majors, emphasizing process-oriented and value-added evaluations. The integration of "theory-practice-quality" and immersive professional scenarios ensures students transition smoothly from learners to innovators.However, challenges persist, such as the need for sustained enterprise involvement and faculty upskilling. Future work should explore digital tools to further streamline "teaching-learning-evaluation" workflows and expand cross-institutional collaborations.

Ultimately, this model not only enriches I&E education but also aligns with broader goals of vocational education reform, cultivating talent tailored to industry needs[9-11].

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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