Exploration of Open Innovation and Entrepreneurship Education Practice Teaching System in Local University Software Engineering Major

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Abstract. Innovation and entrepreneurship education practice teaching is an important part of cultivating talents with innovative spirit and entrepreneurial ability. This paper analyses the problems faced by the current practical teaching system of innovation and entrepreneurship education in local universities in cultivating high-quality characteristic software talents. It also puts forward the concept of open innovation and entrepreneurship education, and is based on the concept of integration of industry and education, and integration of specialization and creation. And with the cultivation of innovation and entrepreneurship spirit as the core, the putative innovation and entrepreneurship education practice teaching system is constructed.The system consists of two modules: in-class practice and extracurricular practice. It contains five practical aspects such as in-class experiment, curriculum design, extracurricular practice, enterprise practice and comprehensive practice. In order to cultivate course-level, project-level, competition-level, enterprise-level and engineering-level professional practice skills respectively. It also integrates course ideology and politics throughout, realizing the organic integration of value leading, knowledge imparting and ability cultivation.

1.Introduction

Software industry is a basic and strategic industry for national economy and social development, and is the source of power to lead a new round of scientific and technological innovation [1]. With the integration and penetration of software and various fields of economic and social development, the digital transformation of various industries continues to deepen. As well as the continuous emergence of new technologies, new models and new business models. The industry is in urgent need of a large number of high-quality characteristic specialised talents and inter-disciplinary talents. Innovation and entrepreneurship education is an important measure to promote the comprehensive reform of higher education and promote high-quality entrepreneurship and employment of college graduates. It is also an important part of the country's major strategic action to build an innovative country [2]. Innovation and entrepreneurship education breaks the talent cultivation model that only focuses on knowledge transfer and ignores practical ability. It comprehensively reforms education and teaching to cultivate talents with innovative literacy and entrepreneurial ability with new teaching concepts [3].

A large number of local universities in China bear the heavy responsibility of cultivating a large number of application-oriented talents. The applied talents cultivated by universities are the backbone of promoting the development of software industry and the main force of serving local economic construction. Practical teaching is the foundation of cultivating applied talents and an important educational mode of software talents training. At the same time, practice teaching is also an important yardstick for the development of innovation and entrepreneurship education and an important part of the teaching of innovation and entrepreneurship education courses in universities [4]. Therefore, the construction of characteristic innovation and entrepreneurship education practice teaching system plays an important role in clarifying the positioning of innovation and entrepreneurship education cultivation, articulating innovation and entrepreneurship education, and promoting the reform of innovation and entrepreneurship education. The system also plays an important role in professional education, supporting the cultivation of talents with innovative spirit and entrepreneurial ability.

2.Current situation of practical teaching system of innovation and entrepreneurship education

In foreign countries, people emphasize the cultivation of innovative and entrepreneurial talents by entrepreneurial universities[5]. Entrepreneurship education is considered to three components of the curriculum, fundamentals, and publications[6], and requires deep collaboration among

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universities, industry, and the government[7]. In recent years, domestic universities have responded to the call of ‘mass entrepreneurship and innovation’ and actively carried out innovation and entrepreneurship education, which has achieved remarkable results. In terms of practical teaching system, Li F. F.[3] constructed the practical teaching system of innovation and entrepreneurship education in applied universities from three aspects. These three aspects are improving the practice teaching system, enriching the practice teaching activities, and building the practice teaching guarantee. Xia Q.[4] analysed the basic structure of integrated innovation and entrepreneurship education practice teaching system and gave its operation design. Zhang T.[8] put forward the values and principles of the construction of the practice teaching system of innovation and entrepreneurship education in universities, and put forward the construction approaches from two aspects. The two aspects are to build the system of entrepreneurship and innovation education activities and improve the teaching mechanism of entrepreneurship and innovation education.

Zhou M.[9] et al. studied the integrated quality education training model of 'inheritance and innovation, cross and integration, collaboration and sharing' under the background of new engineering education. They also constructed a practical teaching system for the integration of quality education and innovation and entrepreneurship. Chen L.[10] constructed an innovation and entrepreneurship practice teaching system under the cultivation of 'five talents training' by taking automobile manufacturing and testing technology as an example. Ru H.[11] constructed a practice teaching system of 'three goal orientation, three classroom linkage, three level progression', and studied its implementation path. Zhang Q.[12] explored the innovative practical teaching system of software engineering under the perspective of professional certification. He proposed a three-dimensional practical teaching system of 'three modules, four platforms and five stages'. Dong Q.[13] proposed a system of practice teaching and innovation ability training for software engineering majors. In order to improve the comprehensive quality of students, to train students to adapt to social development of innovation ability and related professional skills.

In general, a series of research and practice have been carried out in China on the construction principles, construction methods, implementation paths, evaluation methods, and safeguards of the practical teaching system of innovation and entrepreneurship education. And the combination of innovation and entrepreneurship education with professional education, engineering education, new engineering construction, curriculum thinking and politics, and the construction of characteristic demonstration software college has achieved remarkable results in cultivating high-quality and specialised software talents. But for local universities, there are still the following problems.

1) Lack of co-ordination of innovation and entrepreneurship practice teaching system

Currently, local universities lack a top-down unified planning in their innovation and entrepreneurship practical teaching system. This is primarily manifested as follows: unclear training objectives, a lack of distinctiveness and relevance. failure to encompass all students, with individual teachers predominantly leading several student teams separately. In terms of the temporal and spatial aspects of teaching, a phenomenon of prioritizing in-class over out-of-class activities, and a focus on campus-based activities over external ones exists. Consequently, innovation and entrepreneurship practical teaching lacks both breadth and depth.

2) Mismatch Between Innovation and Entrepreneurship Teaching Content and Industry Talent Demand

The current software industry urgently requires a substantial number of specialized professionals with software thinking, mastery of advanced software engineering methods, proficiency in software requirements analysis, architecture design, programming implementation, and quality assurance skills. Additionally, there's a need for professionals who possess industry knowledge, excel in algorithm modeling, and can drive the industrialization of technology. Local universities, apart from offering traditional foundational courses and specialized courses, have introduced courses related to innovation and entrepreneurship, employment guidance innovations, as well as practical knowledge of invention and intellectual property. These courses are integrated into the curriculum through practical components such as experiments, engineering practices, internships, and graduation projects with the aim of cultivating high-quality, specialized talents. However, these courses and their corresponding practical teaching content are rather outdated, significantly deviating from actual project requirements, and failing to align with industry talent demands, thereby hindering the development of students' innovative spirit and entrepreneurial abilities.

3) Limited Effectiveness in the Implementation of Innovation and Entrepreneurship Practical Teaching Activities

In the current innovation and entrepreneurship courses, practical teaching activities are often fragmented or disjointed, revolving around learning tasks and complementing theoretical knowledge. These activities lack coherence and continuity, resulting in lower levels of student engagement [4]. Additionally, due to constraints related to faculty, facilities, and industry-academic resources, the implementation of innovation and entrepreneurship practical teaching activities in local universities has not yielded significant results.

3.Building an open innovation and entrepreneurship education practical teaching system

3.1.The essence of open innovation and entrepreneurship education

Innovation and entrepreneurship education is a new educational concept that revolves around society and is tailored to meet the development needs of an innovative nation. It is neither purely focused on innovation nor solely on entrepreneurship. Instead, it represents the convergence and elevation of both innovation and entrepreneurship education. The objective of innovation and entrepreneurship education is to cultivate highly qualified, versatile individuals with a certain level of innovation and entrepreneurship consciousness, thinking, skills, and personality traits. At its core lies the cultivation of an entrepreneurial spirit, which is primarily characterized by a positive life attitude and unwavering determination.

Open innovation and entrepreneurship education refers to a teaching model that liberalises disciplinary knowledge in innovation and entrepreneurship education, focuses on the connection with society, seeks to integrate interdisciplinary knowledge, and breaks the traditional closed classroom.In the field of software engineering, open innovation and entrepreneurship education places students at the forefront, focuses on problem-solving, and centers around the core principles of an entrepreneurial spirit. It also emphasizes deep collaboration between academia, industry, and technology, with the goal of nurturing highly qualified, specialized software professionals and versatile individuals.

3.2.Open innovation and entrepreneurship education practical teaching system for software engineering major

Based on the concept of integrating industry and education, professional education, and innovation and entrepreneurship education, with a focus on nurturing an entrepreneurial spirit, an open innovation and entrepreneurship education practical teaching system has been constructed (the software engineering major of Chengdu University of Information Technology as an example), as shown in Fig 1. This practical teaching system is comprised of two main modules: in-class practical experiences and out-of-class practical experiences. It encompasses five practical components, namely, in-class experiments, course design, extracurricular activities, industry internships, and comprehensive projects. These components aim to cultivate practical skills at various levels, including course level, project level, competition level, industry level, and engineering level, enabling students to develop a software-oriented mindset, master software engineering methods and algorithm modeling techniques, and apply their software skills and domain knowledge to solve real-world engineering problems. Ultimately, this system aims to equip students with an innovative and entrepreneurial spirit and capability. The practical teaching system possesses the following characteristics.

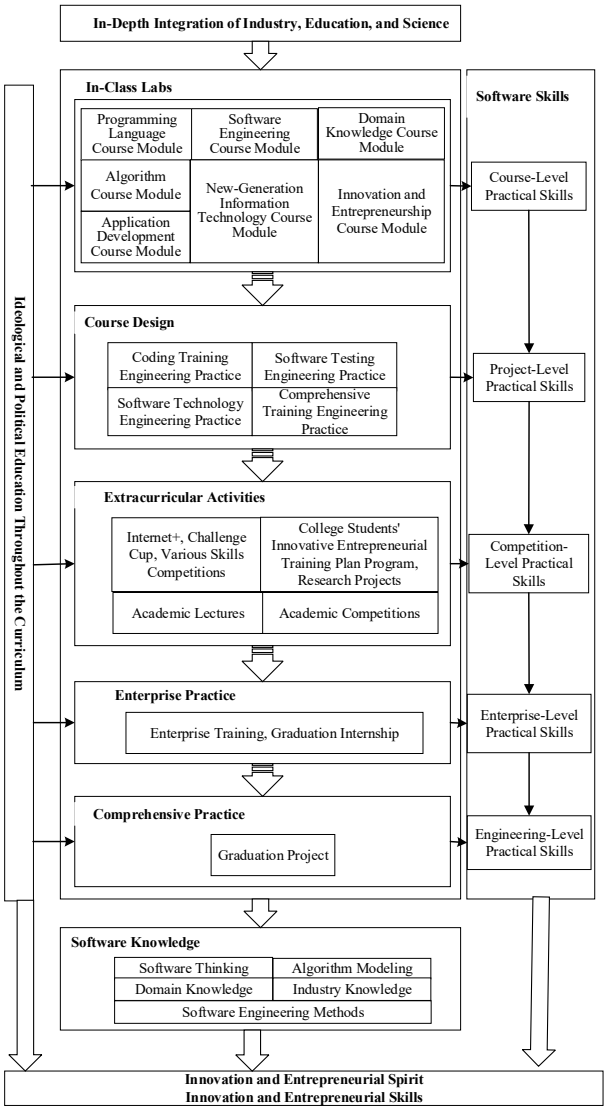

Fig.1. Open Innovation and Entrepreneurship Education Practice Teaching System for Software Engineering Major

1) In-Depth integration of industry, education, and science

Education, scientific research, and social services are the three major functions of universities, with education serving as the foundation for scientific research and social services.The deep integration of science and education, as well as industry and education, combines industry with education and integrates research with teaching, both within and outside the university.This integration creates a collaborative effort aimed at cultivating high-quality innovative talents, thereby supporting the achievement of the functional goals of universities.Through the deep integration of industry, education, and science.local universities can first establish practical teaching resources through cooperation between schools and enterprises, expand the content of practical teaching systems, and address the issue of loose correlation between practical content and actual needs. Secondly they can solve the problem of lack of practice platform by jointly building on-campus innovation and entrepreneurship training bases

and enterprise training bases. Subsequently, they can address the shortage of innovation and entrepreneurship education by introducing enterprise mentors and allowing faculty members to participate in on-the-job training. Finally, through methods such as integrating scientific research into teaching, involving students in faculty research, and implementing mentorship systems, students can receive early research training, addressing the issue of limited coverage of innovation and entrepreneurship education.

2) Progressive In-Class practice modules

The in-class practical module consists of two components: in-class experiments and course design, which include validation experiments, design experiments, comprehensive experiments, course-level engineering practices, and multi-course comprehensive engineering practices.These practical components are organized in a hierarchical and progressive manner.The in-class experiment component is a practical aspect of relevant courses, primarily aimed at helping students grasp fundamental theoretical knowledge.It covers validation experiments, design experiments, and comprehensive experiments in courses such as programming languages, algorithm courses, application development courses, software engineering courses, new-generation information technology courses, domain-specific knowledge courses, and innovation and entrepreneurship courses.These course experiments are developed by carefully designing and decomposing project cases based on the experimental objectives of relevant professional courses. They not only assist students in acquiring theoretical knowledge but also provide training in course-level practical skills.

The course design segment primarily revolves around the content of several courses, with its core being the practical content based on curriculum group development.Chengdu University of Information Technology has designed four main course design projects, namely, Coding Training Engineering Practice, Software Technology Engineering Practice, Software Testing Engineering Practice, and Comprehensive Training Engineering Practice.The Coding Training Engineering Practice begins after the completion of the Introduction to Engineering and C Language Programming courses, focusing on enhancing students' coding skills and code writing standards.The Software Technology Engineering Practice starts after courses like Object-Oriented Programming, Web Application Design, and Database Principles and Applications, emphasizing the development of students' abilities to complete a project.The Software Testing Engineering Practice begins after the Software Testing and Quality Assurance course, providing students with experience in the entire software testing process.Finally, the Comprehensive Training Engineering Practice starts after courses like Software Requirement Engineering, Software Design Engineering, Software Manufacturing Engineering, Software Engineering Project Management, Software Testing and Quality Assurance, and Software Design Patterns. It enables students to comprehensively apply software engineering methods, techniques, and tools to complete a medium-sized system tailored to a specific domain, thereby nurturing their comprehensive practical skills.The course design segment offers project-level practical skills and specialized knowledge for the development of software talents.

3) Diverse extracurricular practice modules

The extracurricular practice modules consist of three components: extracurricular practice, industry practice, and comprehensive practice, primarily focusing on cultivating entrepreneurial and innovative spirit and ability.These modules extend the innovation and entrepreneurship practice system beyond the classroom and the university, determining the breadth and depth of practical teaching.Extracurricular practice activities, through academic lectures, help students understand research hotspots and development trends in their fields, broaden their horizons, and lay the foundation for independent and lifelong learning.By utilizing methods such as student societies, undergraduate mentors, integration of science and education, interdisciplinary teams, and corporate mentors, real projects drive student participation in various innovation and entrepreneurship competitions (innovative design projects, college student innovation and entrepreneurship training programs, subject competitions).This expands student involvement, allowing them to gain a sense of honor and accomplishment in innovation and entrepreneurship competition activities.Students gain a deep understanding of the interdisciplinary and specialized nature of practical teaching in innovation and entrepreneurship education, develop a multi-disciplinary perspective, and foster a three-dimensional innovative mindset, shaping a well-rounded knowledge structure.The extracurricular practice component provides students with competitive-level practical skills, achieving the transition from knowledge to abilities.

The industry practice component mainly includes corporate training and graduation internships.It leverages the strengths and resources of partner companies, enabling students to immerse themselves in real corporate management models and development environments.Students learn cutting-edge technologies applied in enterprise development projects, gaining in-depth insights into the integrated processes of software project analysis, design, implementation, testing, and operation and maintenance.Pre-job training is incorporated into the educational process, providing students with enterprise-level practical skills, contributing to the development of software talent.The comprehensive practice component is primarily conducted in the form of graduation projects.These projects adopt a dual-mentor system, and topics are derived from real enterprise needs and research projects.School mentors and corporate mentors jointly supervise students, requiring them to independently complete a comprehensive software project.This project covers activities throughout the software development lifecycle, including feasibility analysis, requirements analysis, preliminary design, detailed design, software testing, and more.It improves the students' comprehensive practical ability and the ability to analyze and solve complex engineering problems, providing engineering-level practical skills for software talent training.

4) Permeating curriculum with ideological and political education

Curriculum ideology and politics refer to the ideological and political education conducted through curriculum design and classroom teaching.It emphasizes the integration of elements of ideological and political education, including theoretical knowledge, value concepts, and spiritual pursuits, into various courses, subtly influencing students' thoughts, consciousness, and behavior.The core of open innovation and entrepreneurship education is to cultivate students' entrepreneurial spirit, which is manifested as a positive life attitude and unwavering determination.Throughout the entire practical teaching system, curriculum ideology and politics run through each stage, achieving an organic fusion of value guidance, knowledge impartation, and skill development.This ensures that students, while mastering software thinking, algorithm modeling, software engineering methods, industry knowledge, domain knowledge, and software engineering skills, also possess lofty ideals, noble moral character, a positive life attitude, and unwavering determination.

4.Conclusion

Taking the example of the software engineering major of Chengdu University of Information Technology, this study explores the 'two modules, five stages' open innovation and entrepreneurship education and practical teaching system, with a focus on cultivating entrepreneurial spirit.This system encompasses five components: in-class experiments, course design, extracurricular activities, enterprise internships, and comprehensive projects.These components aim to help students acquire skills in software thinking, algorithm modeling, software engineering methodologies, industry-specific knowledge, and domain knowledge, spanning from course-level to project-level, competition-level, enterprise-level, and engineering-level professional practice skills.Simultaneously, it aims to foster students' comprehensive practical abilities, innovation capabilities, entrepreneurial skills, as well as instill in them high ideals, noble moral character, a positive life attitude, and unwavering determination.

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