

Research on the Teaching Reform of Open Source Mode Computer Courses under the Perspective of Innovation and Entrepreneurship Enhancement

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Abstract: With development of open source economies, the reform of the integration of industry and education of college computer courses has taken on a new direction. The purpose of this study is to discuss the features and paths of integrating open source mode into college computer teaching, helping students understand open source ecology, actively participate in open source innovation, and improve innovation ability. We use the research method of literature review and case description. The literature review part summarizes the research trend of open source and the current situation of open source in college education. In the analysis part, we describe the practical integration process of students' participation in open source projects and developers' interaction, and discuss the effectiveness and implementation strategies of this teaching method. The study found that college students' participation in open source projects not only broadened their horizons, but also improved their innovation and entrepreneurial ability in practice. Therefore, the teaching method of open source mode provides a new idea and path for cultivating interdisciplinary talents to adapt to the development of digital economy in the future.

Keywords: Key capabilities; Computer Teaching Reform; Open Source Mode; Innovation and Entrepreneurship

1. Introduction

In the era of the digital economy's rapid growth, information technology innovation drives social progress, with the open source mode playing a pivotal role due to its openness, sharing, and collaboration. Open source is

elevated to a strategic level to drive digital economy and technological advancement. Colleges must innovate teaching modes to keep pace with technological and industrial needs. Traditional computer courses often focus too heavily on theoretical knowledge, neglecting practical innovation and teamwork skills essential for modern high-skilled talent needs. Introducing the open source mode into these courses is a forward-looking reform.

The open source mode aligns with modern education goals by involving students in resource sharing and project collaboration within open source communities. This engagement allows them to experience software development, fostering project management skills and teamwork awareness. Students gain exposure to cutting-edge technologies, understanding design concepts in practice, enhancing problem-solving skills, and stimulating innovation and entrepreneurship. Moreover, interaction with global developers broadens their international perspective, improving language and cross-cultural communication skills. This integration not only enhances educational quality but also meets societal and enterprise needs for diverse talents, marking a strategic move towards educational innovation and modernization.

2. Literature Review

The rise of open source mode. Open source is the open, sharing and derivative innovation of source code ^[1]. By discussing the free collaboration and mutual assistance mechanism among users in the open source software community, it is found that the sharing of source code among developers not only promotes the improvement and innovation of software, but also forms an effective knowledge sharing mode, which

improves the overall technical ability of the community [2]. The incentive mechanism and organizational structure of open source projects and the economic impact and social changes they bring to the traditional business model [3]. Open source is important in promoting innovation and continuous access to external knowledge. Open innovation will further evolve and bring new strategic opportunities and challenges to various industries [4]. The open source repeatable build feature is conducive to the rapid iteration of software projects [5]. In the development process of AI diffusion model, open source as a technical tool plays a vital role [6].

Teaching reform under open source mode. Open source mode can effectively promote education reform and promote the development of autonomous learning and innovation ability [7]. The open source mode will be introduced into computer education to enhance students' practical ability and innovation awareness through actual participation in projects, so as to adapt to future technological and industrial changes. The open source mode challenges the curriculum design and ability requirements of China's software talent training. The study found that the open source mode strengthens the practical skills training, constructs an open and cooperative education environment, and can effectively improve the comprehensive ability of software talents [8]. The open source mode accelerates the innovation process by promoting resource sharing and cooperation and exchange in the proof of concept activities [9]. The construction method and application practice of open source hardware teaching mode under the guidance of design thinking show that the combination of design thinking and open source hardware can effectively promote the improvement of students' innovation ability and practical skills [10]. Taking the "open source software development foundation and practice" course of Peking University as an example, the exploration and practical research of the dual track open source teaching mode under the background of the integration of production and education show that the open source mode can effectively combine industrial resources with education and teaching, and improve

students' practical skills and innovation ability [11].

The open source mode in computer education reform has evolved through three stages: initial exploration (2000-2012), focused on new educational methods; expanded exploration (2012-2021), integrating design thinking with curriculum design; and acceleration (2023-present), achieving a mature dual-track system combining education and industry. This reform is multi-level, impacting teaching methods, fostering autonomous learning and innovation, and enhancing industry-academia collaboration to align educational content with industrial needs, thereby promoting effective educational innovation.

3. Open Source Mode of Computer Courses

3.1 Educational Reform Objectives

The teaching reform goal of open source mode of computer course is to innovate the traditional teaching mode and cultivate students' practical ability and innovative spirit through the concept of openness, cooperation and sharing. The core of the curriculum aims to break the traditional closed curriculum boundary and encourage students to actively participate in curriculum construction, resource sharing and knowledge innovation. The specific objectives include: first, build an open learning platform, cultivate open source culture and collaborative spirit, and let students understand the value and significance of open source; Second, strengthen the practice orientation, guide students to participate in real open source projects, and improve programming skills and collaboration ability; Third, promote the dynamic updating and continuous optimization of teaching content, so that the curriculum can keep pace with the development of Technology (Table 1).

Table 1. Objectives Computer Courses Educational Reform

Objective	Descriptions
Open learning platform	Understanding of open source culture, value.
Practice oriented	Guidance in open source projects to enhance skills.
Dynamic optimization	Introduce technology developments to courses

3.2 Innovations in Teaching Reform

The teaching reform of computer courses

under the guidance of the open source mode is committed to creating a flexible and diverse learning environment for students through openness, cooperation and practical reinforcement, encouraging teachers to adopt open source software and hardware as teaching resources, and ensuring that the course content follows the development trend of the open source industry (Table 2).

Table 2. Features of Teaching Reform

Features	Methods
Openness	Use open source software; hardware; GitHub; Gitee
Innovation	Join open source projects, contribute ideas, codes
Practicality	Project-driven approach; Tech-driven approach

Through platforms like GitHub and Gitee, students engage with the latest technology trends, actively participate in project development, and enhance their autonomous learning skills. This shift transforms traditional teacher-centered methods into collaborative and interactive experiences. Students transition from passive recipients to active participants, applying knowledge through teamwork. Teachers now act as guides and supporters, fostering innovative thinking and knowledge sharing. Open source teaching emphasizes practicality, combining theory with real-world practice and project-driven learning. This "learning by doing" approach ensures students acquire hands-on skills and problem-solving abilities, focusing on the latest technologies to keep learning relevant and forward-looking.

3.3 Technical Expansion

Technical expansion focuses on the practical application of open source software and hardware, helping students master industry-relevant technical knowledge. Core programming languages like Python, Java, and C++ are employed, using IDEs such as Jupyter Notebook and Eclipse for coding and debugging. Students become adept with industry-standard tools, leveraging frameworks like Django, Spring Boot, and Boost, and utilizing version control systems such as Git via platforms like GitHub and Gitee for code management and collaboration. Understanding modern app deployment involves container technologies like Docker and Kubernetes, along with cloud services such as AWS and Azure. In data analysis and AI, libraries like

pandas, NumPy, scikit-learn, and TensorFlow introduce students to data processing and machine learning. Open source hardware like Arduino, Raspberry Pi, BeagleBone, and ESP32/ ESP8266 facilitate hands-on learning in embedded systems, IoT, robotics, and smart devices. Through platforms like GitHub, students collaborate with developers, solving technical challenges, enhancing teamwork and communication skills, and preparing to become innovative talents in a dynamic tech landscape.

3.4 Improving Innovation Ability and Transferring Entrepreneurial Ability

The improvement of innovation ability is realized through resource diversification, project driven, community collaboration and self-directed learning (Table 3). Open source mode provides students with rich resources covering the latest technologies, encourages students to actively retrieve and integrate different solutions, and stimulates innovative thinking and creativity. By participating in the programming tasks of open source projects, students can apply theoretical knowledge to solve specific problems in practice, and then find new methods and ideas, so as to exercise their creativity and problem-solving ability. Community collaboration plays a vital role in improving innovation ability. Autonomous learning can improve students' innovative ability. Students communicate with developers through the open source community, change the technical perspective, inspire thinking, and enhance the innovation potential in team cooperation.

Table 3. Strategies of Open Source Mode to Improve Students' Innovation Ability

Strategies	Description
Diversification	Offer diverse resources with the latest tech trends, cutting-edge knowledge, foster solutions.
Project-driven	Practice with real projects to enhance creativity and problem-solving skills.
Community Collaboration	Forums and communities enable interaction with peers, provide perspectives.
Self-directed learning	Encouraged to customize learning paths, stimulate creativity.

The origin of the Apache IoTDB project can

be traced back to the academic research of Tsinghua University. At the start-up stage, the team is mainly committed to technological innovation and breakthrough, and its members have widely participated in the course study in the field of computer science and software engineering, providing a solid theoretical support for it. Academic ensures the technological advancement and reliability of the project, and also lays the foundation for the subsequent open source. With the gradual maturity of the project, IoTDB chose the open source path, which greatly enhanced the diversity and innovation ability of the project. The participation of the global developer community has not only brought rich contributions to the project, but also realized the wide dissemination of knowledge and technology. For computer science education, participating in open source projects enables students to actually operate real software projects, improve technology application ability and the ability to solve complex problems. In practice, students learn how to manage the code base, version control, write high-quality documents, and collaborate with other developers. The commercialization process of IoTDB project, namely the establishment of Tianmou Technology Inc., provides valuable learning opportunities for enterprise management and entrepreneurial practice. This process involves many aspects from project management to marketing, from customer relationship maintenance to product development. By integrating entrepreneurial experience and knowledge into the teaching of computer courses, students can understand the whole process of technical products from concept to market, and speculate on the challenges encountered and the required strategic adjustments. Students learn how to assess market demand, develop business plans, seek investment and support, and ultimately launch products that meet user needs. The process of Tianmou Technology Inc. continuously optimizing products and solving technical problems shows the dynamic balance between technology and business needs, provides students with the opportunity to learn how to carry out continuous technological innovation and business iteration, and is an important course content for cultivating innovative thinking and adapting to changes. The successful entrepreneurship of the Apache

IoTDB open source project shows that participating in the open source project can help students master key technical skills, such as code base management, version control and writing high-quality documents. This not only improves the students' technology application ability, but also exercises their ability to solve complex problems. The practicality of open source projects enables students to deeply participate in the software development life cycle, which is an important way to transform classroom theory into practical ability.

In the process of maturity and commercialization of the project, IoTDB chose the market-oriented development strategy. This transformation provides students with a comprehensive case of understanding from technology to products, and then to the market. Integrating such open source innovation and entrepreneurship cases will help students understand the importance of market demand assessment, business plan formulation and product promotion. The knowledge and skills of enterprise management and entrepreneurship are crucial for students' future career and entrepreneurial practice. Entrepreneurs and technical experts in the open source community share their experiences and lessons, providing students with an opportunity to directly communicate with mature entrepreneurs. In the course, through participation in community activities, seminars and online forums, students and entrepreneurs' face-to-face communication, in-depth understanding of the challenges faced by entrepreneurship, problem-solving methods and the application of innovative thinking. In the process of actually participating in open source projects, students can practice and apply what they have learned. Open source projects often involve the whole life cycle of products, from concept verification to development, realizing the close combination of theory and practice. At the same time, in the process of cooperating with other developers and entrepreneurs, students have exercised their comprehensive abilities such as teamwork, communication and project management. The open source mode of computer courses helps students systematically build and improve the comprehensive ability required for entrepreneurship by providing real entrepreneurial cases as learning templates and promoting exchanges with entrepreneurs. The

learning method of accumulating experience through practice and exchange enables students to not only master technical skills, but also cultivate excellent entrepreneurial thinking and execution (Table 4).

Table 4. Training Methods for Innovation and Entrepreneurship Capability

Method	Description
Entrepreneurship case studies	Study successful open-source entrepreneurship to understand key aspects and develop framework.
Discussion with entrepreneurs	Learn problem-solving and innovative thinking.
Practical participation	Participating in project management throughout the software life cycle.
Executive force	Master technical skills while cultivating entrepreneurial thinking and executive ability.

3.5 Assessment

The assessment method of open source mode of computer course aims to focus on students' comprehensive ability and practical application, rather than relying solely on the traditional written examination. Course assessment usually includes project assessment. Students need to participate in the actual development of open source projects, so that the assessment criteria are based on students' code quality, project design, innovation and contribution, reflecting students' roles and contributions in team cooperation (Table 5).

Table 5. Assessment Method

Categories	Points	Weight	Method
Process	Contribution	20%	Experiment
	Code review	15%	Report
	Logs	15%	Report
Result	Achievement	25%	Report
	Quality	10%	Experiment
	Availability	10%	Report
	Case study	5%	Assignment
Total		100%	

The purpose of the assessment is to encourage students to reflect and improve themselves through code review and peer review. Students get different perspectives and suggestions from the feedback of expert developers in the open source community to promote self-improvement. Students regularly report and share the project progress and results in the course, so as to cultivate students' ability to

display technology. The course assessment includes small research reports. Students need to analyze the successful cases of open source projects, explore their technology and market strategies and other factors, and provide the basis for cultivating and testing students' research ability.

4. Capability Matrix

According to the discussion in the above section, the education and training of computer courses in the open source mode attempts to stimulate and enhance students' innovation and entrepreneurship ability. Therefore, the teaching method based on practical application and hands-on practice realizes the innovation and entrepreneurship ability matrix (Table 6).

Table 6. The Capability Matrix

Capabilities	Description
Technical	Autonomous Learning
	Problem solving
	Practical application
Collaborative	Teamwork
	Effective communication
Innovative	Innovative thinking
	Rapid iteration
Entrepreneurial	Ethics consciousness
	Open source spirit
Leadership	Project management
	Participation & influence

The open source mode encourages active learning and problem-solving skills, enabling students to transcend the limitations of traditional textbooks and explore knowledge independently in the process of adapting to new tools and technologies, reflecting higher creativity and flexibility. In the open source project, students learn to communicate and collaborate effectively through interaction with global developers, so as to improve cross-cultural communication ability and leadership, and lay the foundation for future international entrepreneurship. The sharing and mutual aid culture of the open source community also fosters students' open source spirit and promotes their innovative thinking and business ethics consciousness. Students learn to quickly use open source tools to build prototypes and promote the sustainable development of the project.

5. Conclusion

Open source mode has significant advantages

in the reform of computer course education. Open source mode is introduced to train students' ability to actively learn and solve practical problems of computer open source software or open source hardware projects. This ability is particularly critical in the era of rapid technology iteration. By exploring new tools and technologies, students can show a high degree of creativity and flexibility in the face of challenges and adapt to different technical environments. Open source mode improves students' team cooperation, cross-cultural communication ability and leadership through cross-border cooperation in real projects, comprehensively cultivates students' technical ability, collaboration ability and innovation consciousness, and builds a talent base for open source innovation and entrepreneurship to "go to sea".

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