Exploration of Micro-professional Construction Mode in Applied Colleges Driven by New Quality Productivity: Taking Software Engineering Major as an Example

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Abstract: Under the background of new quality productivity, software engineering majors in applied colleges and universities face the challenge of transformation from traditional to intelligent and digital. Taking the software engineering specialty of applied colleges as an example, we explore the construction mode of micro major, setting up four modules such as Harmony OS mobile application and AI big model, aiming to cultivate students' interdisciplinary integration, practical innovation and high-tech literacy. The specific implementation plan is proposed through measures such as clarifying the objectives, constructing the system, strengthening the practice, and deepening the cooperation between schools and enterprises. The micro-specialization model is flexible, targeted and cutting-edge, which can quickly respond to market demand, effectively improve students' professional skills and comprehensive quality, meet the industry's demand for high-quality software engineering talents, and provide new ideas for software engineering education.

Keywords: New Quality Productivity; Software Engineering Micro-Major; Interdisciplinary Integration; Practical Innovation Ability; School-Enterprise Cooperation

1. Introduction

In the context of globalization and the information age, a new round of scientific and technological revolution and industrial change is accelerating, with new quality productivity, at its core driven by artificial intelligence, big data and cloud computing, becoming the primary catalyst for economic and social development. The concept of "new quality productivity" delineates the trajectory for China's economic transformation and upgrading, and the pursuit of high-quality development [1]. The future economic development will be characterized by a focus on scientific and technological innovation to lead industrial innovation and the vigorous development of new quality productivity. In this context, higher education, especially talent training in the field of software engineering, faces new challenges. Software engineering is experiencing a transformation from traditional to intelligent, digital, and informatization, and applied undergraduate colleges and universities, as the main position, are in urgent need of reforming the traditional teaching mode and constructing an education system that meets the requirements of new-quality productivity [2].

Micro-major, a novel educational paradigm that is characterized by its flexibility, efficiency and responsiveness to market demands, has garnered significant attention and undergone substantial development on a global scale since its inception at the EDX platform in 2012 [3,4]. The present study focuses on the construction of software engineering micro-major driven by new quality productivity. It takes Harmony OS mobile application, AI big model and other cutting-edge modules as examples, with the aim of cultivating students' interdisciplinary integration, practical innovation and high-tech literacy. Furthermore, it explores new ideas and paths for software engineering education.

2. The New Requirements of New Quality Productivity for Software Engineering Talents

2.1 The Meaning and Characteristics of New Quality Productivity

The advent of a novel form of productivity, stemming from the profound integration of information technology, artificial intelligence, big data, and other state-of-the-art technologies, signifies the emergence of a new era of productivity marked by digitalization, networking, and intelligence as its fundamental constituents. This paradigm shift underscores the pivotal role of technological innovation, while concurrently fostering the profound integration and synergistic development among diverse industries and the deepening and expansion of cross-border cooperation. In the process of promoting high-quality economic and social development, the new quality productivity plays a pivotal role [5].

Firstly, technological innovation has been identified as a primary catalyst for progress. The advent of novel productivity levels has been instrumental in sustaining technological innovation as a pivotal source of power, thereby facilitating the transformation and upgrading of conventional industries, thus giving rise to new economic growth points. Software engineering, as a pivotal cornerstone of technological innovation, exhibits a direct correlation between its innovation capability and application level and the development speed and quality of new productivity levels.

Secondly, the issue of industrial integration and development must be addressed. The advent of a new era of productivity has precipitated the deep integration of disparate industries, thereby giving rise to a novel industrial ecology and value chain system. This phenomenon necessitates that software engineering professionals possess not only a robust foundation of professional technology, but also an interdisciplinary knowledge structure and the capacity to navigate the intricate working environment engendered by industrial integration.

Furthermore, data is instrumental in the decision-making process. The new paradigm of quality productivity utilizes big data resources to provide scientific decision-making support for economic and social development through data analysis and mining. Consequently, software engineers must acquire proficiency in advanced data processing and analyzing techniques and construct efficient data processing systems to support data-driven decision-making in enterprises.

Finally, intelligentization is widely applied. The new quality productivity promotes the wide application of intelligent technology in various fields, which significantly improves the production efficiency and service quality. Software engineering education needs to follow this trend, strengthen the training and application of artificial intelligence technology, and cultivate software engineering talents who can adapt to the intelligent environment and have innovative thinking and practical ability.

2.2 The Impact and Challenges of New Quality Productivity on Software Engineering Education in Colleges and Universities

The rapid development of new quality productivity has had a profound impact on software engineering education in colleges and universities and has raised new challenges. First, the technology iteration is accelerated and the demand continues to change. The rapid development of new quality productivity has shortened the technology iteration cycle, and software engineering technology is changing day by day. Software engineering education in colleges and universities needs to keep up with the pace of technological development and constantly update the teaching content to ensure that students master the most cutting-edge technology. However, the traditional teaching system is slow to update, and the course outline lags behind the industry demand, resulting in a disconnect between the teaching content and the actual demand [6]. For this reason, colleges and universities need to build a flexible teaching mechanism, regularly update course content, introduce new technologies, and encourage students to participate in extracurricular learning and practice. Secondly, interdisciplinary integration and high comprehensive quality requirements. New quality productivity-driven software engineering is increasingly focusing on interdisciplinary integration, such as artificial intelligence technology research and development needs to be combined with computer science, mathematics, psychology and other multidisciplinary knowledge. Therefore, colleges and universities need to focus on enhancing students' interdisciplinary thinking, innovation and teamwork abilities while cultivating their professional and technical abilities. The curriculum should focus on interdisciplinary cross, provide

diversified elective courses and practice opportunities. Once again, strong practical ability and high innovation ability are required. The new quality productivity has put forward higher requirements for the practical ability and innovation ability of software engineering talents. Enterprises pay more and more attention to students' project experience and practical operation ability, as well as innovative thinking. The software engineering field is constantly emerging new technologies and new applications, which requires talents with innovative thinking to promote the development of the industry. Therefore, colleges and universities should strengthen practical teaching, provide rich practical opportunities and project experience, and encourage students to participate in research projects and innovative entrepreneurial activities to cultivate their practical ability and innovation ability.

3. Characteristics of Micro-Major and Its Application Strategies in Software Engineering Education

3.1 Definition, Characteristics and Advantages of Micro-major

Micro-professionalism, a novel educational paradigm that emerged in response to the demands of social progress, particularly in the context of emerging technologies and industries, seeks to transcend the conventional boundaries of traditional disciplines and majors. This paradigm aspires to refine and construct a series of core curriculum systems centered on specific academic domains, industrial development frontiers, or professional core qualities. The model is meticulously designed to empower students to broaden their skill set while pursuing their majors, thereby enhancing their personal competitiveness in the job market.

First, micro-professions exhibit a high degree of flexibility, enabling them to respond promptly to market demands and technological advancements. This flexibility is evident in their ability to adjust the curriculum in a dynamic manner, ensuring that students acquire the most current skills and knowledge. Consequently, micro-specialization emerges as a highly effective strategy for cultivating new talents and catering to the rapidly evolving needs of the industry. Second, micro-specialties possess a strong relevance to specific fields or skills, offering students the opportunity to acquire in-depth training in their chosen discipline. This results in the development of professional knowledge and practical abilities, significantly enhancing students' employability. Furthermore, micro-professions align with the forefront of technological development, incorporating the latest technological achievements and knowledge. This ensures that students remain at the forefront of technological advances and accurately grasp the latest developments in their respective industries. Additionally, micro-professions adopt a modular design approach. The curriculum system of micro-professions employs a modular design, with each module concentrating on a particular skill or knowledge point. This approach enables students to select modules aligned with their individual interests and needs, while also allowing universities to adapt the curriculum content in response to market demands. Finally, micro-professions are results-oriented. The micro-professional's emphasis on results-oriented learning is predicated on the final mastery of skills and knowledge, with the evaluation criteria directly reflecting the effectiveness of student learning. This approach aligns with the actual needs of enterprises and society for talent [7].

3.2 Principles of Building a Software Engineering Micro-Major

The establishment of a software engineering micro-profession must adhere to several core principles to ensure its educational quality and practicality. Primarily, there is a necessity for demand orientation and market adaptability; that is, the construction of the program must closely follow the latest developments in the software industry and technological advances, and the curriculum system and teaching content must be planned in conjunction with the specific needs of enterprises for talent. The educational content's timeliness and practicality can be ensured through in-depth communication and cooperation with the industry. Secondly, the education concept of interdisciplinary integration and comprehensiveness should be implemented to break the traditional discipline boundaries and integrate the knowledge of computer science, mathematics, management, and other fields.

This will cultivate talents with comprehensive literacy and cross-border thinking, meeting the demand for composite talents in the new era. It is also imperative to emphasize the principles of practical innovation and ability-oriented education. The profession must prioritize the cultivation of students' practical abilities and innovative spirit. Employing project-based learning, school-enterprise collaboration, and other diversified teaching methods can provide students with real-world opportunities and innovation spaces, facilitating the transformation of knowledge into skills. Furthermore, the software engineering micro-specialty must adhere to the principle of internationalization and maintain an open perspective. It is essential to establish cooperative relationships with internationally renowned universities and enterprises, introduce global advanced educational resources and teaching concepts, and provide students with broader academic horizons and career development platforms.

3.3 Construction and Implementation Strategies for Software Engineering Micro-Major

In order to ensure the efficient implementation of software engineering micro specialization, the first task is to clarify the cultivation objectives and positioning of the profession, closely integrate with the market demand and technological evolution trends, formulate practical cultivation programs and teaching plans, and maintain sensitivity and timely adjustment and optimization. Secondly, it is necessary to build a scientific and reasonable curriculum system, realize interdisciplinary integration around the training objectives, pay attention to the cultivation of practical innovation ability, continuously update the teaching content and methods, and introduce cutting-edge software technologies and tools to ensure that students master the latest knowledge and skills. In addition, it is also crucial to strengthen the construction of teaching staff, which should introduce excellent talents through multiple channels, strengthen the training and development of on-the-job teachers, and hire experienced enterprise experts to jointly build a high-quality and specialized teaching team to provide solid support for the construction of micro-professionalism. At the same time, improve teaching facilities and experimental conditions, strengthen laboratory construction and management, configure advanced software tools and development platforms, and cooperate with enterprises to build training bases and R&D centers to provide real practice environments and opportunities to enhance students' ability to solve practical problems. Deepening practical teaching and school-enterprise cooperation is also key. Diversified teaching methods such as project-driven, case study, internship and practical training should be adopted to strengthen the practical teaching link, and work closely with enterprises to jointly formulate talent cultivation programs and teaching plans, promote the deep integration of industry-academia-research and utilization, and provide more employment opportunities and development space for students. Finally, implement a flexible teaching management and evaluation mechanism, establish a sound teaching management system, strengthen the supervision and management of the teaching process, establish a scientific and reasonable evaluation system, standardize the teaching behavior and improve the quality of teaching, adopt the credit system to adapt to the different learning needs and habits of students, stimulate the interest in learning and motivation, and adjust and optimize the teaching plan and course content in time through the regular teaching evaluation and feedback mechanism, to ensure that the software engineering micro-professionals can learn and develop their skills and knowledge[8]. Through regular teaching evaluation and feedback mechanism, timely adjust and optimize the teaching plan and course content to ensure the sustainable and healthy development of the software engineering micro-major.

4. Exploration of Software Engineering Micro-Professional Construction Mode Driven by New Quality Productivity

4.1 New Quality Productivity-Driven Ideas for Building Software Engineering Micro-Professions

In the context of contemporary engineering disciplines, confronted with the evolving trends and challenges precipitated by technological innovation and industrial upgrading, there is an imperative to recalibrate

the educational paradigm to align with the demands of the new era of scientific and technological revolution. This recalibration entails a close integration of software engineering micro-specialties with the evolving needs of industrial technology and the diverse development requirements of students. The establishment of four distinct micro-professional modules, namely Harmony OS Mobile Application, AI Big Model, Xinchuang Intelligent Development, and Harmony OS Internet of Things, is central to the proposed initiative. The objective of this initiative is to nurture software engineering professionals who possess the capacity to adapt to the evolving technological landscape and address the demands of the evolving market. The initiative proposes a framework for the development of software engineering micro-professionalism driven by new quality productivity (as depicted in Figure 1).

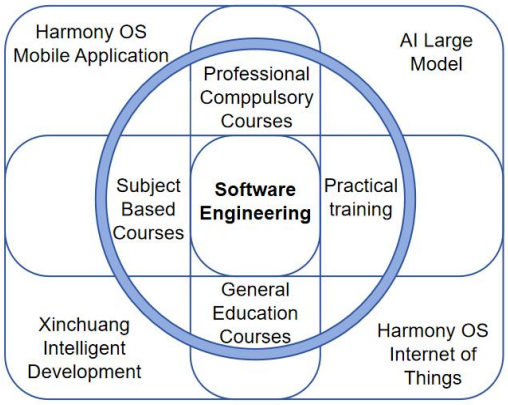

Figure 1. A Framework for New Quality Productivity-Driven Software Engineering Micro-Major

(1) Harmony OS Mobile Application Module: With the wide application and popularization of Harmony OS system, Harmony OS mobile application development has become a new hot spot in the software industry. This micro-specialty aims to cultivate high-quality talents with the ability of Harmony OS system application development, so as to meet the market's urgent demand for Harmony OS application development.

(2) AI Big Model Module: AI Big Model, as a core technology in the field of artificial intelligence, is leading a new round of scientific and technological revolution and industrial change. This micro-profession will focus on the R&D and application of AI big models, aiming to cultivate talents who can master the key technologies of big model construction, training and optimization, and provide strong support for the innovative development of the AI field.

(3) CCTI Intelligent Development Module: As an important cornerstone of national information security, CCTI industry is ushering in unprecedented development opportunities. This micro-specialty will focus on the R&D and application of CCTV technology, and train talents with CCTV system intelligent development ability, in order to promote the rapid development and growth of CCTV industry.

(4) Harmony OS Internet of Things Module: As an important part of the new generation of information technology, the Internet of Things is gradually penetrating into all aspects of social life. Combined with the IoT characteristics of Harmony OS system, we cultivate talents with Harmony OS IoT system design and development ability to meet the demand for high-quality talents in the field of IoT and promote the wide application and in-depth development of IoT technology.

4.2 New Quality Productivity-Driven Software Engineering Micro-Major Course Program Design

The software engineering micro-professional course program (Figure 2) has undergone a process of refinement and improvement based on the aforementioned construction ideas. The program leverages the resources of the two provincial first-class professional construction sites in the college's software engineering and computer science and technology departments, offering opportunities for junior students to align their academic pursuits with the technological advancements of the current era. The program's objectives include promoting interdisciplinary integration among students, expanding their intellectual horizons, and enhancing their professional competencies and overall quality.

The Micro-specialization I curriculum encompasses courses such as "Harmony OS System Architecture and Development Fundamentals" and "Atomized Service Development Technology." These courses are designed to cultivate students' proficiency in Harmony OS system application development, encompassing various aspects including system architecture, service development, and cloud native technology. The Micro-

specialization II curriculum is similarly structured, with courses that include "Harmony OS System Architecture and Development Fundamentals" and "Atomized Service Development Technology." AI Big Model Direction, which includes courses such as "Basic Theory of Deep Learning and Big Model" and "Introduction and Practice of Generative Artificial Intelligence." These courses are designed to provide a comprehensive exploration of the research, development, and application of AI big models. Micro-specialization III: Xintron Intelligence Development Direction, which includes courses such as "Rise Machine Learning Fundamentals and Applications" and "Rise Deep Learning Technology and Practice." These courses are centered on the R&D and application of Xintron technology. Micro-specialization IV: Harmony OS Internet of Things Direction, which includes courses such as "Harmony OS Operating System Fundamentals and Advancement" and "Harmony OS Intelligent Device Development Basic Technology." These courses integrate the Internet of Things characteristics of the Harmony OS system to cultivate the ability of Internet of Things system design and development.

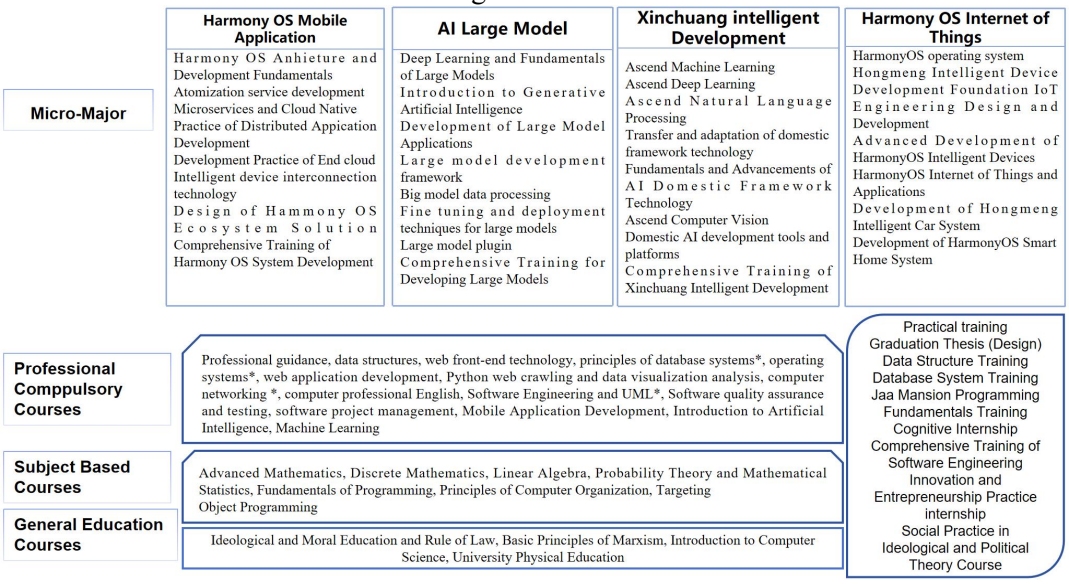

Figure 2. Software Engineering Micro-Specialization Course Program

4.3 Mechanisms for the Implementation and Operation of Software Engineering Micro-Major

The implementation and operation mechanism of software engineering micro-professionalism establishes a scientific and systematic teaching mode based on the connotative characteristics of new quality productivity, the development trend of software engineering, as well as combining industrial demand and school characteristics.

The initial step in this process is the formulation of teaching objectives. These objectives are derived from several sources, including the requirements for new quality productivity, the most recent developments in software engineering, and the specific industry demands for talent and the pedagogical characteristics of the institution [9]. The fundamental objective of this initiative is to ensure that students acquire a comprehensive understanding of the fundamental theories of software engineering and the practical skills necessary to competently execute the entire lifecycle of software projects. This encompasses the analysis of requirements, the design of systems, the development and implementation of these systems, and the subsequent maintenance of these systems. The initiative is designed to equip students with the ability to independently or collaboratively undertake the entirety of a software project, thereby preparing them to meet the demands of the software engineering industry. The overarching objective of this program is to cultivate students' professionalism, thereby aligning with the industry's demand for diversified and high-level talents.

Secondly, the integration of industry and education occupies a pivotal position in this mechanism. Through in-depth cooperation

with industry-leading enterprises, joint planning of talent cultivation programs, collaborative construction of curriculum frameworks, joint training of faculty, as well as the joint establishment of practical training bases, we ensure a close match between the teaching content and the actual needs of the industry [10]. Concurrently, the incorporation of state-of-the-art technology and authentic industry case studies enables students to engage with the most recent technological advancements and genuine work scenarios during their educational journey. This integration serves to remarkably enhance their professional acumen and practical capabilities.

Furthermore, practical teaching is given high priority. The implementation of a project-driven teaching method, in-depth analysis of actual cases, and the encouragement of students to actively participate in various professional skills competitions are all strategies that have been employed to allow students to effectively exercise their practical skills. These strategies have also been shown to stimulate their innovative thinking and teamwork spirit. In addition, the provision of corporate internships and project cooperation opportunities has built a broader practical platform for students, enabling them to further refine their professional skills in a real work environment.

At the level of teaching organization, the micro-professional program implements a stringent credit system, mandating that students must meet the prescribed credit requirements before graduating successfully. Concurrently, in order to adapt to the learning needs and habits of different students, the program adopts flexible class organization and diversified teaching forms, including online teaching, offline lectures, and hybrid teaching modes combining online and offline. The quality of teaching is ensured by continuous supervision and management of students' learning processes.

Furthermore, the management and assessment of students must be given due consideration. A multifaceted and scientific assessment system is implemented to evaluate students' overall performance in theoretical knowledge mastery, practical skills application, and innovation ability. Mechanisms such as credit replacement and completion certificates are provided to fully recognize students' learning achievements and efforts.

Finally, to ensure the continuous improvement and enhancement of the teaching quality of micro-specialties, a perfect teaching quality guarantee and supervision system has been established. The micro-professions are fully integrated into the university's teaching quality assurance system, and in-depth teaching quality assessment activities are carried out regularly so as to identify problems in time and make targeted adjustments and optimize the teaching plan and curriculum. Concurrently, an effective reward mechanism is instituted to motivate teachers and students who demonstrate exceptional performance in teaching to persist in their endeavors and pursue innovative growth.

4.4 Evaluation and Feedback Mechanism of the Effectiveness of Software Engineering Micro-Professional Construction

In order to ensure the effectiveness of the software engineering micro-professional construction and achieve continuous improvement, a set of comprehensive assessment and feedback mechanism has been constructed. Firstly, through diversified evaluation methods, such as course assessment, project practice, innovation competition and enterprise internship, students' professional skills, practical ability and innovation ability are comprehensively and thoroughly evaluated, and a detailed student learning file is established to track their growth trajectory. Secondly, the teaching quality of teachers is evaluated regularly, covering multiple dimensions such as teaching attitude, level and method, and external evaluation by industry experts and enterprise representatives is introduced to ensure the objectivity and comprehensiveness of the evaluation, which is then used as an important reference for teachers' performance appraisal, and teachers are encouraged to actively participate in teaching reforms and researches. Furthermore, the reasonableness of the curriculum is reviewed regularly, the curriculum system is adjusted in time to keep pace with the market demand and technological development, and industry experts are invited to participate in the decision-making of the curriculum, so as to enhance the practicability and foresight of the curriculum. In addition, an evaluation mechanism for the effectiveness of school-

enterprise cooperation is established to comprehensively assess the results and impact of the cooperation program and adjust the cooperation strategy according to the feedback from the enterprises, so as to enhance the effectiveness and relevance of school-enterprise cooperation. Finally, through the continuous improvement and feedback mechanism, it summarizes and analyzes the problems in the construction process of the micro-major in a timely manner, and collects the opinions and suggestions from experts, teachers and other parties in order to adjust and optimize the construction plan in a timely manner, so as to ensure that the software engineering micro-major can be continuously improved and developed.

4.5 Case Study: Harmony OS Mobile Application Micro-Professional Construction Practice

In order to provide a more thorough illustration of the application effectiveness of the novel quality-productivity-driven software engineering micro-professional construction model, the Harmony OS mobile application micro-professional construction is selected as a case study for in-depth analysis.

First, this micro-profession is predicated on the integration of the core concept of new quality productivity and advanced technology in the construction process. Through a carefully constructed system of core and elective courses, it has comprehensively cultivated students' ability to develop Harmony OS system applications. The course system encompasses fundamental theories, including the Harmony OS system architecture and atomized service development. Moreover, it employs project-driven, case study, and other practical teaching methods to effectively enhance students' practical skills and innovation abilities.Secondly, to ensure the precise alignment between talent cultivation and industrial demand, the Harmony OS Mobile Application Micro-professional actively seeks in-depth collaboration with industry-leading enterprises. It participates jointly in the formulation and implementation of talent cultivation programs and teaching plans. This integrated approach, which combines the strengths of industry, academia, and research, ensures that course content aligns with technological advancements and industry dynamics. Moreover, it provides students with a substantial practical platform and employment opportunities. By engaging in enterprise research projects, internships, and other activities, students can apply their professional skills to real-world projects while acquiring the latest industry trends and technical knowledge. Moreover, the micro-professional program has established a comprehensive feedback mechanism, systematically collecting students' and teachers' opinions and suggestions through questionnaires and in-depth interviews. These feedback loops provide a vital foundation for the perpetual enhancement and optimization of the micro-major, ensuring the sustained improvement of teaching quality.

The empirical evidence indicates that the implementation of the Harmony OS mobile application micro-major has yielded favorable outcomes. Students have demonstrated notable enhancements in their professional competencies and overall quality, thereby addressing the pressing market demand for proficient Harmony OS application development professionals. This successful instance substantiates the viability and efficacy of the novel quality productivity-driven software engineering micro-major construction model, offering valuable insights and educational materials for the development of micro-majors in other academic institutions and disciplines.

5. Conclusion

This paper thoroughly examines the construction model of software engineering micro-major driven by new quality productivity. The objective of this examination is to cultivate students' interdisciplinary integration ability, practical innovation ability, and high-tech literacy by establishing micro-major modules such as Harmony OS mobile application and AI big model. The research findings offer novel concepts and approaches for software engineering education in institutions of higher learning. These findings are of paramount importance in addressing the demand for high-quality software engineering talent in the new quality productivity era. In the future, with the continuous progress of technology and the continuous innovation of educational concepts, the construction of software engineering micro-major will be more

diversified and personalized. Colleges and universities should continue to deepen the education and teaching reform, strengthen the cooperation between schools and enterprises, promote the deep integration of industry, academia, and research, and contribute to the cultivation of software engineering talents adapted to the requirements of the new era. Concurrently, it is imperative to maintain a keen awareness of the evolving trends and dynamics in the realm of software engineering education both domestically and internationally. This necessitates the continual introduction of novel educational concepts and methodologies, thereby fostering continuous innovation and advancement in the development of software engineering micro-major.

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