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Construction and practice of industry–university integration-oriented “3+1” modular talent training system: A case study of internet of things engineering major in local undergraduate universities

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Abstract: The “3+1” modular talent training system based on industry–university integration is a key path to bridge the gap between IoT engineering talent cultivation in local undergraduate universities and industry demand. However, the system operation is constrained by problems such as inadequate teacher practical competence, disconnected curriculum and industry, and imperfect guarantee mechanisms. Taking the IoT Engineering major as the research object, this paper analyzes the status quo and core problems of the system, explores influencing factors, and puts forward targeted optimization strategies, aiming to improve the system's effectiveness and provide reference for similar professional reforms.

Keywords: local undergraduate universities; “3+1” model; industry–university integration; IoT engineering; talent training system science.

1. Introduction

Since China expanded its higher education enrollment in 1999, local undergraduate universities have hired more than 1 million young teachers, who have grown into the core force in cultivating application-oriented talents. As the digital economy thrives, China's IoT talent shortage had surpassed 2 million by 2025. However, the traditional closed training mode of local universities—prioritizing theory over practice—fails to meet industry demands for interdisciplinary talents. Building the “3+1” modular system grounded in industry–university integration has thus become an inevitable path.

This research carries both theoretical and practical significance. Theoretically, it enriches studies on industry–university integrated talent training and fills gaps in the operational details of the “3+1” model. Practically, it develops a replicable training plan to boost students'



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employability and strengthen universities' ability to serve regional economies. This paper analyzes the system's current situation, existing problems and influencing factors, and explores optimization approaches.

2. Status quo of the “3+1” modular talent training system

Most local undergraduate universities have implemented the “3+1” model for IoT Engineering, forming a dual structure of “on-campus foundation+ enterprise empowerment”. The first three years focus on modular learning: basic modules (Advanced Mathematics, Python Programming) lay a solid foundation; core modules (Sensor Technology, IoT System Design) enhance professional skills; pre-practice modules (simulation experiments, course design) bridge theory and practice. The final year involves enterprise internships, where students participate in real projects to complete their graduation designs and adapt to workplace roles.

Young teachers with solid professional backgrounds, actively adopt modern teaching methods to promote modular courses. Yet their performance has obvious shortcomings: lack of enterprise project experience leads to teaching that overemphasizes theory and neglects application; limited by research resources, they cannot integrate enterprise project achievements into teaching; inexperience in curriculum design and practice management hinders their role adaptation, restricting the system's effectiveness.

2.1. Core deficiencies of young teachers in system implementation

Firstly, insufficient teaching experience. Most young teachers start teaching without systematic training or teaching assistant experience, resulting in incomplete teaching processes, unsystematic content and inflexible methods, with weaknesses in course design and classroom management.

Secondly, ineffective integration of research and teaching. Despite strong research potential, young teachers are constrained by funding and platforms; many fail to integrate research into teaching, leading to a disconnect between teaching and research.

Thirdly, difficulties in role adaptation. Transitioning from researchers to teachers, they lack practical teaching experience, struggle to adjust their thinking and methods, and face challenges in adapting to the teaching environment and building teacher-student relationships.

3. Problems in the “3+1” system's operation mechanism

The system's operation faces four core problems that affect talent training quality and young teachers' development.

3.1. Homogeneous and outdated modular contents

Existing modules focus on traditional theories, lacking coverage of cutting-edge technologies such as IoT security and edge computing. Enterprise-customized courses

account for less than 5%, and without industry training, young teachers cannot update content in line with industrial iterations, leading to a mismatch with job requirements.

3.2. Imperfect training and guarantee system

The young teacher mentorship system is formalistic: on-campus mentors focus on theory, while enterprise mentors lack time for systematic guidance, with vague rights and responsibilities. The training system lacks continuity, emphasizing theory over practice, and the connection between on-campus learning and enterprise practice is weak.

3.3. Insufficient practical opportunities and platforms

On-campus laboratories have outdated equipment and insufficient core instruments; off-campus practice bases are limited in quantity and cooperation depth, only providing visits and auxiliary work. Platforms such as teaching observation and skill competitions are lacking, restricting the practical improvement of young teachers and students.

3.4. Unbalanced evaluation and incentive mechanisms

The evaluation system focuses on theoretical scores (accounting for over 70%), ignoring young teachers' contributions to practical teaching and school-enterprise cooperation. There is a lack of targeted incentives; their workload in curriculum co-research and practice guidance is not quantified, dampening their enthusiasm.

4. Optimization strategies for the “3+1” modular system

The purpose is to interpret and compare results and point out the features and limitation of the work. Relate the research to current knowledge in the field.

4.1. Build competence-oriented modular content

Reconstruct the three-level module system, adding cutting-edge modules such as IoT security. Establish an “industry-university dual-teacher co-research” mechanism, decompose enterprise projects into teaching cases, and organize regular industry training for young teachers to enhance their curriculum design capabilities.

4.2. Improve practical platforms and training mechanisms

Upgrade on-campus comprehensive laboratories integrating simulation, R&D and training; build stable off-campus practice bases with leading enterprises, and provide young teachers with at least one month of annual enterprise secondment. Establish platforms for teaching observation, skill competitions and seminars to strengthen their practical teaching abilities.

4.3. Stimulate motivation with scientific incentives

Set up special incentive funds, giving priority to title evaluation and performance bonuses for outstanding teachers in system reform. Clarify the rights and responsibilities of on-campus and enterprise mentors, and establish regular communication mechanisms to form educational synergy.

4.4. Establish multi-dimensional assessment and feedback mechanisms

Improve the evaluation system, increasing the proportion of practical teaching, school-enterprise cooperation and module optimization to 40%. Regularly assess young teachers' abilities, use the results to optimize training content and platforms, and encourage self-assessment and reflection.

Declaration of Generative AI and AI-assisted Technologies

The authors did not use generative AI or AI-assisted technologies in the writing of this manuscript.

During the preparation of this manuscript, the authors used generative AI tools only to improve language and readability. The authors take full responsibility for the content of the manuscript.

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Authors' contribution

Conceptualization, methodology, investigation, resources, data curation, writing—original draft preparation, writing—review and editing, Wang Jun; supervision, project administration, Luo Ze. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest

The author declares no conflicts of interest.

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