

# Talent Training Model of Craftsmen Workshop in Integrated Circuit Major of Applied Undergraduate Colleges

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**Abstract:** The craftsman workshop style talent cultivation model of “project integration and four in one” can effectively solve the problems encountered in the current talent cultivation of integrated circuit majors in our university. Specifically, the method is to first provide school and enterprise mentors for freshmen and sophomores in the first semester, and carry out basic theory and practical learning. In the second semester of sophomore and junior years, students will be dispatched and led to enterprises for professional practical learning. During this period, the school and enterprise will establish specialized craftsman workshops, and students will choose real projects, teacher research topics, and competition activities based on their own preferences, so as to ultimately complete professional practical teaching that fully meets the needs of enterprises.

**Keywords:** integrated circuit; craftsman workshops; training model; applied college; practical learning

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## 1. Introduction

The development of society and economy relies on talents. It can be said that talent cultivation largely determines the development of a society and a country, and its role cannot be ignored [1]. Against the backdrop of the rapid renewal of scientific and technological productivity and constant changes in demands, the traditional education model has been difficult to meet the needs of new development. This requires continuous innovation and development to closely integrate education with social development, so as to provide more outstanding talents for society and the country. In this regard, the Ministry of Education attaches great importance to the development of higher education and has begun to strengthen efforts to promote industry-university cooperative education. The purpose is to address the problem of low alignment between talent cultivation and social needs, enabling education to provide precise services for the development of society and the country. However, the intensity of the international technological competition environment has been increasing in recent years, exerting a certain impact on China's scientific and technological development. Particularly in the field of chips, China has a strong dependence on imports, making the cultivation of chip talents an urgent issue to be resolved in China. Therefore, based on national development policies, this research comprehensively analyzes from the perspectives of the talent needs of enterprise development and the characteristics of integrated circuit majors in universities. By adopting the approaches of industry-university cooperative education and the integration of industry and education, it continuously innovates and optimizes teaching models and strategies, strengthens the cooperation in the industry-university-research integration, and better connects talent cultivation with enterprise needs. The aim is to cultivate more outstanding integrated circuit talents with high quality, innovative capabilities and strong practical skills, effectively alleviate the technological blockade strategy adopted by

Western countries, and provide internal impetus for China's sustainable development.

## 2. Connotation and Construction Process of the Workshop-Based Training Model for Integrated Circuit Majors

As a form of higher education, the workshop-based education model for integrated circuit (IC) majors aims to cultivate high-quality talents with innovative awareness, innovative capabilities, and comprehensive competence.

IC professional workshops primarily integrate electronic components—such as transistors, diodes, and capacitors—onto semiconductor wafers or dielectric substrates using precision processing technologies, ultimately completing the design of microcircuit structures with corresponding functions. In this process, it not only facilitates the consolidation, exploration, and development of IC technologies but also provides rich experience and material foundations for research projects and teaching activities.

The teaching content of IC professional workshops covers theoretical knowledge and practical processes, with the ultimate goal of developing finished products. It includes precision hands-on operations, sophisticated and rigorous circuit design, and careful and comprehensive testing procedures [2]. Through systematic learning and practice, these workshops cultivate high-quality IC talents who possess practical abilities, innovative spirits, and solid theoretical foundations.

Workshops help students gain a systematic and in-depth understanding of IC technologies and principles, master design and practical skills, and enhance their teamwork capabilities as well as project management proficiency. By well integrating theory with practice and emphasizing hands-on operations and innovative development, IC professional workshops not only address the shortage of IC talents but also

provide internal impetus for the development of the IC industry, thereby continuously advancing national economic growth and the improvement of scientific and technological capabilities.

### **3.Establishment of the "Project-Oriented, Four-in-One" Workshop-Based Training Model for Integrated Circuit Talents**

#### **3.1 Establishment of a University-Enterprise Talent Cultivation Community Relying on Workshops**

The integrated circuit industry is developing at a rapid pace. Against the backdrop of enterprises' urgent demand for integrated circuit talents, our university has collaborated with a number of electronic enterprises in Shandong Province to establish integrated circuit workshops since 2020. This decision of our university, on one hand, can better meet the strategic needs of the integrated circuit industry, and on the other hand, set a model for school-enterprise collaboration.

Workshops are built within enterprises, which provide students with corresponding workstations and a broader development environment. These workshops introduce enterprises' advanced and sound management systems as well as high-end technologies. Meanwhile, the university, with its abundant teaching resources, strong faculty team and systematic curriculum system, complements the advantages of enterprises and advances in coordination with them, so as to achieve a win-win goal.

The school and enterprise adopt a dual-director management model for the workshops. This model means that the enterprise and the university respectively assign personnel to manage the workshops, providing guarantees for the workshops' work in talent cultivation and technology development. At the same time, the workshop management system is jointly formulated by the university and the enterprise. This not only maximizes the sharing and utilization of integrated circuit resources, but also clarifies the goal of cultivating integrated circuit talents. It emphasizes the importance of both theoretical knowledge and practical experience, and adopts a team-based training method. The curriculum system focuses on theoretical knowledge, skill training and innovation cultivation, with the teaching content carefully and detailedly designed.

In addition, regarding talent selection and evaluation, the university and the enterprise jointly formulate a transparent, fair and scientific evaluation mechanism to ensure the cultivation of high-quality and high-level talents. Various academic exchange activities and school-enterprise collaboration platforms are organized to help students acquire broader knowledge. While improving their professional quality, students can also broaden their horizons, which promotes the improvement of resource development level. The ultimate goal is to cultivate more outstanding innovative and comprehensive talents, and provide impetus for the development of the integrated circuit industry [3].

#### **3.2 The "Project-Integrated, Four-in-One" Training Model**

##### *3.2.1 In-Workshop Teaching: Solidifying Theoretical Foundations and Enhancing Students' Practical Skills and Innovative Competence*

A key limitation of traditional teaching models is their failure to closely integrate theoretical knowledge with practical application, resulting in graduates who are ill-suited to meet

enterprises' actual needs—a major challenge for educators. In contrast, in-workshop teaching effectively bridges theory and practice by reinforcing theoretical understanding through hands-on experience and innovation, while simultaneously honing practical abilities. Within the workshop, students' learning and practice are driven by real projects and competitions. This approach not only strengthens their theoretical knowledge and technical proficiency but also aligns their development more closely with enterprise talent requirements and industry trends. By participating in practical projects, students systematically review and consolidate theoretical concepts, develop problem-solving capabilities, accumulate practical experience, and foster innovative thinking. This innovative teaching method significantly boosts students' learning motivation, which in turn becomes an intrinsic driver for their long-term development [5].

##### *3.2.1 In-Workshop Development: Facilitating Dual Improvement of Students' and Teachers' Capabilities*

In-workshop development is a critical component of the workshop-based teaching model, playing a pivotal role in enhancing both teachers' instructional capacities and students' learning outcomes. A defining feature of in-workshop development is its enriched curriculum content—textbook and classroom learning are complemented by diverse practical components, including real enterprise projects, competition-related tasks, and research initiatives. This expanded content exposes students to a broader range of knowledge, enhances their practical skills, and cultivates their practical competence and innovative thinking through engagement with authentic projects. For teachers, this model also provides opportunities to refine their teaching, project development, and management skills. Participation in real enterprise R&D projects improves teachers' technical expertise, elevating the overall competence of the teaching team. This, in turn, enhances the quality of subsequent teaching and optimizes instructional effectiveness. Furthermore, **graduates trained through in-workshop development possess not only solid theoretical foundations but also strong practical abilities, excelling in hands-on tasks such as technology R&D, innovation and entrepreneurship, and programming—laying a robust foundation for their future careers.**

##### *3.2.3 In-Workshop Competitions: Establishing a Systematic Competition Training System to Boost Students' Innovation*

In-workshop competitions are another core element of the workshop model. Competitions stimulate students' inherent potential and learning interest, while serving as a benchmark to assess their academic progress. The development of in-workshop competitions involves designing comprehensive, detailed training plans to integrate curriculum teaching with competitive activities, creating an assessment system that evaluates students' theoretical knowledge, technical skills, and innovative capabilities. Competition content is designed to balance depth and breadth, with a focus on practicality and richness, encouraging active student participation. By promoting a holistic competition-oriented mindset, students are motivated to continuously unlock their potential and confidently showcase their talents. Innovative experimental classes are formed through a rigorous selection process; these classes organize competitions and project development activities to sustainably stimulate and enhance students' innovative awareness and capabilities. A systematic training mechanism is established within these classes to provide students with platforms to demonstrate their skills, identify gaps in their knowledge, and pursue targeted improvement—ultimately fostering continuous self-development. Through

competitions, students develop a strong interest in scientific knowledge and form habits of independent learning, contributing to the cultivation of talents with strong innovation, broad expertise, and high comprehensive competence.

### *3.2.4 Entrepreneurship Incubation: Cultivating Students' Employability and Innovation*

Entrepreneurship incubation is one of the most distinctive components of workshop teaching, primarily aimed at enhancing students' innovation and employability. In this process, schools and enterprises collaborate to generate internet-based project orders, which are assigned to students. Workshop directors provide guidance and support to ensure students successfully complete their tasks. For projects that meet implementation criteria upon completion, the workshop offers resources such as venues, funding, and client connections to facilitate their practical execution. This model enables enterprises to better control technical and service costs, while students gain a sense of accomplishment from transforming theoretical knowledge into tangible outcomes—improving their chances of success in future entrepreneurship or employment. Entrepreneurship incubation maximizes students' autonomy and learning enthusiasm, ensuring projects are implemented efficiently and effectively. Additionally, it provides a valuable reference for the deeper integration of enterprise development and higher education.

## **4 Characteristics of the "Project-Integrated, Four-in-One" Innovative Workshop-Based Talent Training Model**

### **4.1 In-Depth School-Enterprise Collaboration for Joint Workshop Construction**

The integrated circuit industry has experienced accelerated growth in recent years, prompting higher education institutions to place greater emphasis on integrated circuit education and strengthen collaboration with enterprises to cultivate high-quality, innovative talents. Our university has partnered with multiple provincial enterprises to establish a series of workshops, all adopting the dual-director management model to deepen the integration of enterprise project resources, technical expertise, school resources, and faculty strengths. In workshop operation and development, decisions regarding curriculum objectives, teaching plans, talent cultivation, and selection are made collectively, guided by industry standards, enterprise needs, and talent development goals. A key priority is maximizing the utilization of teaching resources to align talent cultivation with enterprise requirements, producing graduates with solid theoretical knowledge, strong practical skills, and innovative capabilities—thereby providing sustained support for the development of the integrated circuit industry.

### **4.2 Full-Cycle Project Integration and Project-Driven Practical Teaching**

The workshop model integrates in-workshop teaching, in-workshop development, competitions, and entrepreneurship incubation into a cohesive process. Through in-workshop teaching, students not only acquire theoretical knowledge but also apply it to practice via enterprise projects, innovation initiatives, and competitions—enhancing their practical skills and achieving the integration of theory and practice. Moreover, project development serves as a core channel and carrier for learning; participation in real projects enhances students' problem-solving abilities and stimulates their

innovative thinking. Meanwhile, competitions provide a means to assess students' learning progress; results are used to optimize and adjust the training mechanism. Since the implementation of this model, students have gained access to real project development opportunities and received enhanced training in theory, practice, and innovation—greatly benefiting their future career prospects.

### **4.3 Joint Management by On-Campus and Corporate Tutors for Comprehensive Improvement of Students' Practical Competence**

On-campus tutors and corporate tutors collaborate in workshop management, coordinating school-enterprise resources to improve utilization efficiency. They provide guidance to students during project development and offer support for cutting-edge technologies. To enhance project development efficiency and teaching quality, specialized innovative experimental classes have been established, enabling students to participate in innovation projects, entrepreneurship incubation, and competitions. This not only improves students' comprehensive abilities but also ensures the optimal use of school-enterprise resources. The training mechanism for these experimental classes focuses on knowledge sharing and collaborative skills, with regular seminars and discussions to elevate the overall competence of the team. Additionally, the workshop organizes expert training and guidance sessions to help students stay updated on industry developments and cutting-edge trends. Practical experience has demonstrated that this model not only addresses the talent shortage in the integrated circuit industry but also serves as a valuable reference for school-enterprise cooperation.

## **5 CONCLUSIONS**

This study explores the workshop-based talent training model for integrated circuit majors in undergraduate institutions, based on the "dual-tutor guidance" framework. It promotes the complementary advantages of university lecturers and enterprise engineers, providing students with a platform to integrate theory and practice. By introducing real enterprise projects into teaching, students' learning motivation is stimulated, shifting their approach from passive to active. Through the development of multiple projects, students apply theory to practice and use practical experience to deepen their understanding of theoretical concepts—enabling them to master integrated circuit knowledge more systematically and thoroughly. Following the implementation of the "four-in-one" model, teaching, research, practice, and innovation have been more deeply and broadly integrated, significantly advancing talent cultivation. Students have expanded their knowledge scope, developed greater learning interest, and been motivated to explore further. During project development, students have cultivated a strong "craftsman spirit" through problem identification, problem-solving, and exploration. Since the model's implementation, students have won numerous national and provincial awards in integrated circuit-related fields—representing an approximately 40% increase compared to previous periods. This confirms the effectiveness and feasibility of the workshop-based talent training model, which also enjoys high student satisfaction. In the next phase, the outcomes of this study will be used to promote the "project-integrated, four-in-one" workshop model in other colleges and universities. In conclusion, the workshop-based talent training model achieves win-win outcomes for both schools and enterprises. Undergraduate

institutions with integrated circuit majors should actively adopt this model to enable students to enhance both theoretical and practical abilities through projects, cultivating more talents for the integrated circuit industry and driving the sustainable development of China's integrated circuit sector.

## 6. References

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