

Research on the Cultivation of Integrated Circuit Talents in the Industry 4.0 Era

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Abstract. The integrated circuit industry is a key power leading the new round of information revolution and technological transformation in the industry 4.0 era. The development of integrated circuits cannot be separated from the joint support of practical and innovative talents. The issue of talent cultivation in universities has become one of the key factors restricting the development of integrated circuit industry in our country. We fully combines the advantages of the application-oriented training mode of private undergraduate programs, and is committed to establishing a characteristic curriculum system that adapts to the new industrial era. It innovatively combines the training of practical engineers with the soft science management talents. We form a differentiated training mode with the electronics majors of first-class universities, and fill the gap of integrated circuit talents.

Keywords: Integrated Circuit Talents; Industry 4.0 Era; Cultivation.

1. Introduction

At the 2015 National People's Congress and the Chinese Political Consultative Conference, the Prime Minister proposed in the government work report that we should fully enter the Chinese version of the Industry 4.0 era, which has led to a series of interdisciplinary talent needs such as intelligent manufacturing, interconnection and communication, and integrated development[1]. In 2020, the Ministry of Education and the Academic Degrees Committee of the State Council jointly issued a document setting integrated circuit science and engineering as a first level interdisciplinary field, and the direction of integrated circuits has become a key industrial development in China[2]. Considering technological disruption caused by the Industry 4.0, reshaping the abilities of education and building integrated circuit developers is crucial for higher education institutions[3].

In terms of talent demand, facing the gathering of numerous electronic communication design companies in the Greater Bay Area, a large amount of talent supply will be needed in the future. In recent years, the demand for integrated circuit graduates from domestic universities has increased. Nanfang College can fully leverage its geographical advantages, fill gaps, cultivate unique integrated talents for private universities, and improve employment rates and the reputation.

In terms of social value, integrated circuit is a key breakthrough area for China to break free from technological monopoly. The state vigorously supports the difficulty of tackling "bottleneck" technology, which not only requires high-level and cutting-edge technical talents, but also a large number of applied talents with short training cycles and can quickly carry out work. At present, the development of the industry is facing numerous difficulties. As a leading private college, cultivating practical talents and soft science talents who can devote themselves to cutting-edge disciplines in the country is also a heavy and long-term mission and responsibility.

From the view of Nanfang college, establishing the training direction of integrated circuit in electronics majors can increase the depth and breadth of the discipline and enhance its competitiveness. However, in graduation projects, about 10% of students majoring in electronics will select the topics of integrated circuit. In the employment investigation, about 2% of students are engaged in industries related to integrated circuits. Therefore, it is necessary to introduce relevant methods to improve students' skill in integrated circuit. In electronics major of Nanfang college, the main difficulties include the following aspects.

The first problem is the shortcomings in teaching staff. The vast majority of teachers have educational backgrounds other than those in the field of integrated circuit, which means that teachers have no way to start cultivating integrated circuit. The main reason is that talents related to integrated circuit can receive higher salaries in enterprises, while lower salaries in private college prevent them to be teachers.

Secondly, the teaching and experimental equipment for integrated circuit is generally relatively expensive. The private colleges have limited investment in experimental equipment, which also makes it difficult to carry out experimental teaching of integrated circuit.

Thirdly, the distribution of theory and practice in curriculum system lack of coherence. Further exploration is needed on how to connect the basic and core courses of integrated circuit.

Finally, in the era of Industry 4.0, integrated circuit has become a national strategic development estate. Further solutions are needed to combine ideological and political elements with curriculum system of integrated circuit.

From above discussion, for the purpose of improving the quality of teaching in curriculum system of integrated circuit, cultivation mode of integrated circuit talents in the Industry 4.0 era is necessary to be promoted.

2. Cultivation Objectives

In knowledge objectives, it is necessary to make students be aware of cutting-edge technologies of Industry 4.0, understand the current status and industry chain of integrated circuits and master circuit design methods for integrated circuits and electronic circuits. Furthermore, we conduct students to proficiently use chip layout design software and practice integrated circuit project management processes and methods.

From the view of capability objectives, through a series of courses, students are trained to engage in circuit design, layout design, and project management position in integrated circuit design companies, process production lines, EDA software companies and project management enterprises. We improve their ability to solve complex problems, expand their knowledge, and cultivate their continuous independent learning ability to enter higher levels of scientific research.

As seen in value objectives, in the era of Industry 4.0, it is imperative to cultivate students' spirit of striving for excellence. And integrated circuit is key to the country's major development strategy, and they are also key technologies leading economic and social development. This also requires students to possess the responsibility and historical mission entrusted by the times. With patriotism as the theme, we need to educate students to constantly strive for self-improvement in the field of integrated circuit.

In term of service development objectives, we cultivate technology talents for the integrated circuit industry, which are layout design engineers and circuit testing engineers with short cycles and quick work capabilities. On the other hand, we cultivate talents for inheriting circuit project services: soft science talents in integrated circuit projects that are in short supply can conduct project management and research.

3. Cultivation Plans

3.1 Curriculum plans

Facing with the increasing demand for integrated talents in the country, we integrate and aggregate existing course resources in three directions.

Firstly, for the basis courses, continuing to enrich and consolidate existing achievements, we add targeted courses on analog and digital circuits that are related to integrated circuit. We clarify the continuity and transition between connected course, achieve a hierarchical and progressive approach, and optimize basis knowledge for integrated circuit.

Secondly, for the core courses, we integrate the engineering resources of enterprises and strengthen the integrated talents of cutting-edge disciplines. Besides, we optimize design and experimental courses, cultivate practical talents, and provide layout and testing engineers with low entry barriers and high demand.

Thirdly, for the cross courses, based on the characteristics of our college's talents, we combine technology and management to innovatively cultivate composite talents in integrated circuit direction. From a systematic perspective, we structure and integrate soft science, natural science, and ideological and political education.

3.2 Industrialization of training plans

Based on the purpose of cultivating applied talents in our college, in order to increase the competitiveness of graduates from private colleges in cutting-edge disciplines, we integrate and gather existing enterprise resources in three steps.

Firstly, in engineer specialization, the college has many years of experience and achievements in cultivating "Excellent Engineers" and "Cuiying Classes". Based on these training modes, we collaborate with interdisciplinary dual teacher types to complement courses, increase practical training projects for EDA courses, and add hardware project practical content for project management courses. Forming a complete project-based learning process and increasing students' project experience can be realized.

Secondly, for extensive professionalization of enterprise resources, Guangzhou Yueqian Company provides students with the training and internship environment required for new industries and engineering. Through Guangzhou Unicom Company, the courses are made more specialized, increasing the cutting-edge nature of the courses. With the help of Wuhan Lingte Company, a series of virtual simulation online and offline experimental environments are provided. And the training types of software required for enterprises are expanded on the existing EDA simulation platform, which can increase students' practical experience.

Thirdly, for industrialization of achievements, we help students to transform scientific research achievements into protectable articles, patents, and soft works. Besides, we improve students' soft science, increase specialized training on achievements transformation, add application channels and writing training links for students, enhance transformation awareness, and increase students' transformation achievements.

The last plan is the enterprise training of teachers. College teachers generally lack practical experience in integrated circuit engineering, which also leads to students not being able to receive advanced teaching. Therefore, it is necessary to send teachers to enterprises to learn related integrated circuit research and development technologies. On the basis of teachers having sufficient experience in integrated circuit research and development, we increase the number of graduation thesis topics of integrated circuits, and encourage more students to participate in the research and development.

3.3 Soft science training plans

Taking into account the unique characteristics of students in private college, innovate and develop soft science capabilities based on integrated circuit disciplines. In order to improve students' interdisciplinary comprehensive abilities, the following two aspects are proposed to make up for the shortcomings of scientific research achievements.

The first plan is adding engineering project management courses. Based on practice, oriented towards decision-making, integrating natural sciences and humanities, we integrate disciplinary competitions, innovation and entrepreneurship projects, and project management software to build engineering management courses that are different from software project management.

The second plan is project interaction with different college. To address the complex and systematic issues in decision-making and management practices, through complementary courses

between different college, we provide approaches, plans, measures, and countermeasures for students' communication.

4. Summary

Due to the crucial role of integrated circuit research and development in national strategic development, more research on integrated circuit must be carried out in undergraduate teaching. However, private undergraduate college has insufficient investment in integrated circuit. In this situation, curriculum plans, industrialization of training plans and soft science training plans are proposed in this paper to cultivate the undergraduate students' comprehensive ability of integrated circuit.

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