Exploration on the Through Training Mode of Curriculum Group for Students Majoring in Integrated Circuits

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Abstract: With the change of the demand for professional talents in the integrated circuit industry, the disadvantages of the traditional training model are gradually highlighted. This article focuses on the cultivation of students majoring in integrated circuits, and explores the through-training mode of curriculum groups. By analyzing the relevant theoretical basis, such as the concept of curriculum group, the theoretical source of through-training and related education and teaching theories, it provides support for the construction of new model. In view of the problems existing in the current curriculum system, such as curriculum independence and poor connection, this article constructs a through-going training model for curriculum groups from the aspects of training objectives, curriculum setting, teaching methods and teachers. At the same time, the paper clarifies the key points of the implementation of this model, including establishing a scientific teaching management system, integrating teaching resources and coping with implementation difficulties. The research shows that this model is helpful to break down curriculum barriers, improve students' knowledge systematization and practical innovation ability, provide a more effective path for the cultivation of integrated circuit professionals, and meet the industry's demand for high-quality professionals.

1. Introduction

In the process of modern science and technology development, integrated circuit, as the core and foundation of information technology industry, plays a vital role in promoting economic growth and scientific and technological innovation [1]. From smart phones, computers to high-end servers, from Internet of Things devices to artificial intelligence systems, almost all electronic devices rely on integrated circuits to realize their functions [2]. With the rapid development of emerging technologies such as 5G, big data and cloud computing, the demand for integrated circuit professionals not only continues to increase in number, but also puts forward more stringent requirements in quality and capability structure [3]. However, at present, the cultivation of students majoring in integrated circuits in China faces many challenges. There are defects in the curriculum system, and the courses are independent of each other, lacking in systematicness and coherence. It is difficult for students to build a complete knowledge system and have insufficient understanding of the whole process of integrated circuits from design to manufacturing [4]. Teaching methods are traditional, with one-way knowledge imparting as the main method, ignoring the cultivation of students' practical ability and innovative thinking, which leads to students often being helpless when facing practical engineering problems [5].

Under this background, it is of great practical significance to explore the through training mode of curriculum group for students majoring in integrated circuits. The through-going training mode of curriculum group aims to break down the barriers between courses, realize the organic integration and connection of curriculum content, and enable students to systematically master professional knowledge and skills [6]. Through this mode, it is helpful to improve students' ability to solve complex engineering problems, cultivate integrated circuit professionals with innovative spirit and international competitiveness, and meet the needs of rapid industrial development.

Based on the relevant education and teaching theories, this article will deeply analyze the current situation of the curriculum system of integrated circuit specialty, build a through-going training model for curriculum groups, and discuss its implementation points. It is hoped that this research

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can provide useful reference for the cultivation of IC professionals and promote the high-quality development of IC industry in China.

2. Related theoretical basis

Curriculum group refers to a collection of courses that are logically related in knowledge, methods and problems within a certain discipline [7]. Its constituent elements include curriculum objectives, curriculum content, teaching methods and teaching evaluation. Curriculum group has the characteristics of systematicness, relevance and integration, and emphasizes the mutual support and synergy between courses in order to improve the teaching effect and the quality of personnel training.

The theoretical sources of through-training mode are rich and varied. System theory holds that everything is an organic whole, and all parts are interrelated and interact with each other [8]. In the field of education, the curriculum system can be regarded as a system. As subsystems, only through organic integration and integration can the overall function be optimized. Constructivist learning theory emphasizes learners' active construction function, and holds that learning is that learners acquire knowledge through meaning construction with the help of others and necessary learning materials in certain situations [9]. Through-training mode focuses on building a coherent learning situation for students and guiding students to actively build a knowledge system, which is in line with the constructivist learning theory.

In addition, the education and teaching theory related to the integrated circuit professional curriculum group through training also includes Bloom's educational goal taxonomy. This theory divides educational goals into three areas: cognition, emotion and motor skills, which provides a theoretical basis for the setting of curriculum goals and teaching evaluation. In the integrated circuit professional course group through training, scientific and reasonable course objectives can be formulated according to this theory, so as to ensure that teaching activities are targeted and comprehensively improve students' professional quality and comprehensive ability [10]. Together, these theories have laid a solid foundation for the construction and implementation of the through-type training mode of integrated circuit professional curriculum group.

3. Construction of through-type training mode for curriculum group of integrated circuit specialty

At present, the curriculum system of integrated circuit specialty covers many fields of knowledge, but the courses are relatively independent and the connection is not good. Some courses are repetitive, but there are gaps in key knowledge nodes. For example, the course of integrated circuit design focuses on theoretical framework and the course of layout design focuses on practical operation, and there is no effective transition guidance between them, so it is difficult for students to smoothly transform design concepts into actual layouts. Moreover, practical teaching is out of touch with theoretical courses, and most practical links are confirmatory experiments. Students follow the established steps and lack deep integration and innovative application of knowledge.

To build a through-going training model for curriculum groups, we must first make clear the continuous and progressive training objectives. In the lower grade stage, we should focus on cultivating students' basic knowledge, so that they can master basic knowledge such as circuit principle and semiconductor physics, and lay a solid foundation for subsequent study. Senior students focus on the cultivation of professional core skills and engineering practice ability, such as integrated circuit design and manufacturing technology, and finally enable students to have the ability to solve complex engineering problems independently and become professionals who meet the needs of the industry. The structure of integrated circuit professional course group is shown in Table 1.

The curriculum should break the traditional curriculum boundary. The curriculum system needs to be optimized and reorganized around key aspects such as integrated circuit design, manufacturing, and testing, and the rational allocation of teaching resources can be achieved by integrating

repetitive content. For example, the course of circuit analysis, analog circuit and digital circuit is integrated into the basic course of integrated circuit, and the circuit principle and design method are systematically explained; Offering integrated circuit whole process practice course, covering the whole process from design to testing, and strengthening students' comprehensive application ability of knowledge. At the same time, cutting-edge technology courses, such as artificial intelligence chip design and quantum integrated circuit, should be added to the curriculum to broaden students' horizons and keep up with the development trend of the industry.

Table 1: Architecture of Integrated Circuit Specialty Course Cluster

Course Level	Course Name	Main Content
Basic Courses	Circuit Analysis	Circuit elements, circuit laws, circuit analysis methods, etc.
	Analog Electronics Technology	Semiconductor devices, amplifier circuits, integrated operational amplifiers, etc.
	Digital Electronics Technology	Logic algebra, gate circuits, combination logic circuits, etc.
Core Specialty Courses	Semiconductor Physics	Semiconductor crystal structure, carrier movement, etc.
	Integrated Circuit Design	Design process, design methods, layout design, etc.
	Integrated Circuit Manufacturing Process	Process steps such as photolithography, etching, doping, etc.
Expansion Courses	RF Integrated Circuit Design	Basic theories of RF circuits, RF devices and circuit design, etc.
	System-on-Chip Design	System architecture design, hardware-software co-design, etc.

Teaching methods adopt diversified strategies. Theoretical teaching combines case analysis and project-driven, taking the actual case of integrated circuit products as the starting point, guiding students to analyze and solve problems and stimulating students' interest in learning. Practice teaching promotes school-enterprise cooperation, so that students can participate in real projects of enterprises, understand the latest technology and process standards of the industry, and improve their practical operation ability. At the same time, the school can use virtual simulation technology to build a virtual laboratory, so that students can carry out complex experimental operations in a virtual environment and reduce the cost and risk of experiments.

The construction of teaching staff is the key to the implementation of the security model. We should encourage teachers to participate in enterprise practice, accumulate engineering experience and improve their engineering literacy. The introduction of senior engineers in enterprises has injected practical experience and the latest technology into the teaching team. The teaching team composed of teachers from different professional directions effectively promotes the integration and fusion of curriculum knowledge through collaborative teaching and research activities. Through the above-mentioned construction, a scientific, systematic and coherent training mode of integrated circuit professional course group will be formed, which will lay a solid foundation for training high-quality integrated circuit professionals.

4. Key points of the implementation of the through-type training mode of curriculum group

The effective implementation of the through training mode of curriculum group can not be separated from the matching teaching management system. First of all, we need to build a scientific curriculum assessment system. It is difficult to comprehensively evaluate students' ability to master and apply the knowledge of the curriculum group by the traditional examination method based on the final exam. The new assessment system should pay attention to process evaluation and increase the proportion of homework, classroom performance and project practice in the total score. The proportion of assessment is shown in Table 2, which comprehensively considers the learning effect of students from multiple dimensions and encourages students to actively participate and think deeply in their daily study.

The integration and utilization of teaching resources is very important for this training mode. In laboratory construction, we should build a multi-level and comprehensive experimental platform. The basic experimental platform meets the needs of students for basic principle verification and basic skills training. The professional experimental platform is equipped with advanced equipment

and software tools for the core links of integrated circuit design and manufacturing. The innovation experimental platform encourages students to carry out independent innovation projects and explore cutting-edge technologies. The platforms are organically connected to provide students with a complete experimental path from foundation to frontier. The compilation of teaching materials should closely focus on the knowledge system and training objectives of curriculum groups. The compilation of a series of textbooks breaks the limitations of a single curriculum textbook and effectively strengthens the coherence and progressiveness of knowledge between courses. In the teaching materials related to integrated circuit design, the basic design principle is expounded first, and then the design method of complex system is gradually introduced, and the application in different design stages is illustrated with practical cases. The process of compiling textbooks should refer to industry standards and norms to ensure the practicality and timeliness of the content.

Table 2: Weight Distribution of Process-based Assessment for Integrated Circuit Specialty Course Cluster

Assessment Item	Proportion of Total Score	Specific Description
Regular Assignments	30%	Covering theoretical knowledge application and practical operation tasks, regularly assigned and graded
Classroom Performance	20%	Including enthusiasm and accuracy in participating in discussions, answering questions, etc.
Project Practice	50%	Graded based on the results of completing integrated circuit-related projects and team collaboration performance

In the process of implementation, there may be some difficulties and obstacles. On the one hand, there are challenges for teachers to adapt to the new teaching mode. Under the traditional teaching mode, teachers are used to teaching independently, and the through-training mode of curriculum group requires teachers to strengthen teamwork and jointly design teaching content and methods. In this regard, schools should organize teacher training, invite experts to give lectures and share experiences, and promote exchanges and cooperation among teachers. On the other hand, the renewal and investment of teaching resources are under pressure. With the rapid development of integrated circuit technology, experimental equipment and teaching materials need to be updated in time. Schools need to increase funding, establish a long-term cooperation mechanism with enterprises, and obtain the latest technical support and resource sharing.

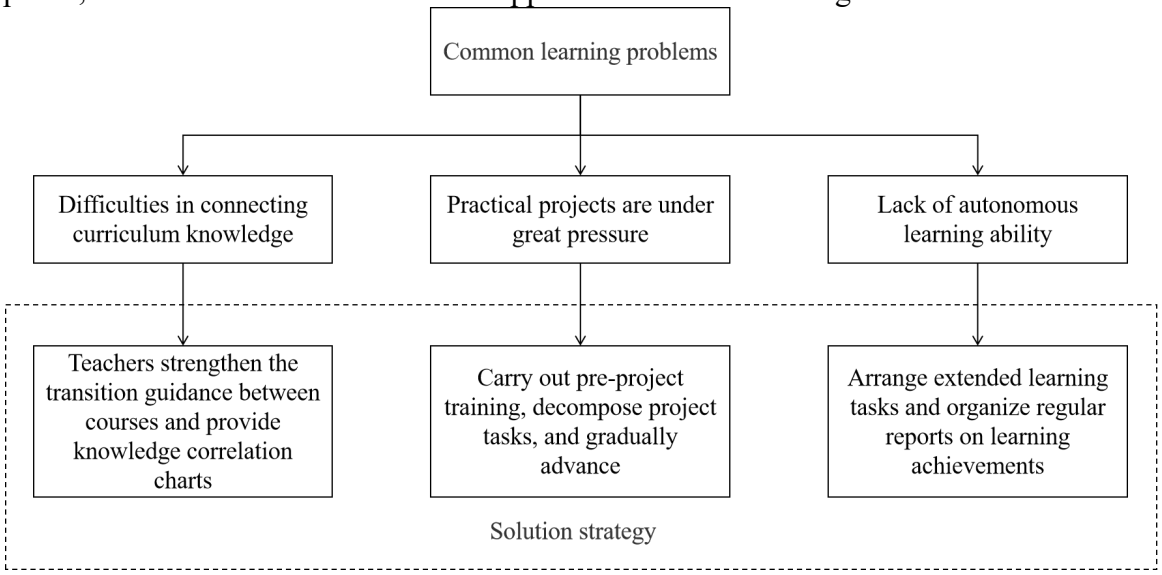

Figure 1 Students' learning problems and solving strategies

Students also need guidance to adapt to the new learning rhythm and way. Under the mode of through-training of curriculum groups, the courses are closely related, and the learning difficulty and depth increase. Teachers should help students make study plans and guide them to learn the integration and transfer of knowledge. Through the establishment of learning support groups, we

can promote exchanges and cooperation among students and jointly solve problems encountered in learning. As shown in Figure 1, specific solutions to common learning problems are formulated to ensure that students can smoothly adapt to the new training mode and improve their learning effect.

5. Conclusions

In this article, the through training mode of curriculum group for students majoring in integrated circuits is deeply explored. Under the background that the integrated circuit industry is booming and the demand for professional talents is increasing, the shortcomings of traditional training mode in curriculum connection and practical teaching are becoming more and more obvious. It is expected to improve this situation in many ways by constructing a through-going training model for curriculum groups.

From the perspective of the construction of training mode, a systematic and comprehensive learning framework has been established for students by defining the continuous and progressive training objectives, integrating the curriculum, adopting diversified teaching methods and strengthening the construction of teachers. The optimization of the curriculum system has broken down the barriers between various disciplines, helping students gradually build a complete ability system from basic knowledge to professional skills, from theoretical learning to practical application. In terms of implementation points, scientific teaching management system, reasonable integration of teaching resources and effective response to implementation difficulties provide a guarantee for the landing of training mode. Through the process assessment, the construction of multi-level experimental platform and the compilation of serialized teaching materials, students' all-round development can be promoted and their ability to adapt to industrial development can be improved.

To sum up, the through training mode of curriculum group can effectively improve the training quality of students majoring in integrated circuits and enhance their ability to solve complex engineering problems and innovative spirit. However, in the process of popularization and continuous optimization, it is still necessary to pay attention to the development of technology, constantly adjust and improve the teaching content and methods, so as to better adapt to the rapidly changing needs of the integrated circuit industry and deliver more high-quality professionals for the industry.

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