Exploration and Research on the Construction of High-level Major Group of Computer Application Technology Under the Background of Digital Economy

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Abstract. With the deepening of the construction of the Guangdong-Hong Kong-Macao Greater Bay Area and the vigorous development of the digital economy in the region, the digital economy will become a distinctive feature of the Greater Bay Area. With the continuous advancement of industrial transformation and upgrading and digital economic construction, the demand gap for high-quality technical and skilled talents in the construction of regional economy will also become larger and larger. In the process of building a provincial-level high-level Major Group of computer application technology, our school actively explores and studies the characteristics of the new generation of information technology and digital economy-related talent training, and carries out in-depth school-enterprise cooperation. Both schools and enterprises jointly carry out teaching method reform and teacher training, Textbook construction. The aim is to improve the professional ability of students in Major Group in multiple aspects, cultivate more talents in the digital economy that meet the needs of enterprises and society, improve the ability to serve regional economic development, and achieve the purpose of high-quality employment in schools.

1. Introduction

1.1 Background

In November 2020, the Guangdong Provincial People's Government accelerated the development of Guangdong's digital economy in order to thoroughly implement the "Outline of the Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area" and the strategic deployment of the Party Central Committee and the State Council on the development of the digital economy, and realize the transformation of the quality and efficiency of economic development[1]. According to the requirements of the "National Digital Economy Innovation and Development Pilot Zone Implementation Plan", the "Guangdong Province Construction of a National Digital Economy Innovation and Development Pilot Zone Work Plan" was formulated. The work plan calls for seizing the favorable opportunity of building an international science and technology innovation center in the Guangdong-Hong Kong-Macao Greater Bay Area, sticking to problem orientation, and strengthening the digital economy around key links such as factor circulation, core technology industry development, digital transformation, digital governance, and digital economic infrastructure construction. Efficient allocation of innovative elements, giving full play to the important value of data as a key production factor of the digital economy, moderately advanced deployment of new infrastructure systems, focusing on improving digital productivity, deepening 5G, mobile Internet, Internet of Things, artificial intelligence, big data, cloud computing, regional The integration and application of next-generation information technology such as block chain, vigorously cultivate new business forms and new models, accelerate the pace of digital transformation in various fields of economy and society, explore new ideas, new models, and new paths for the innovation and development of the digital economy, and summarize and form a batch of innovations that can be replicated and promoted The development experience will lead and drive the accelerated development of China's digital economy. In terms of talent training, actively carry out diversified talent training models such as the order system and modern apprenticeship system, cultivate application-oriented, technically skilled digital economy and technical talent teams, and create "digital craftsmen"[2].

In September 2022, the Ministry of Human Resources and Social Security and other departments, in order to further promote the development of the digital economy, accelerate the technological innovation of the digital economy, further cultivate digital talents, improve digital literacy and digital skills, in the "People's Republic of China Occupational Classification Ceremony (2022 Edition) " conference, for the first time identified 97 digital occupations.
1.2 Significance

From the various documents and notices at all levels mentioned above, it is clear that with the renewal and iteration of digital technology, there has been an important impact on the change of production methods and the readjustment of industrial structure. With the development of the times and the advancement of technology, the demand for digital skills in various industries is rapidly increasing with the development of digital economy. Cultivating new technical skill talents who adapt to the needs of the digital economy and possess digital skills is the core of China's digital skills strategy in the new era. To promote the digital transformation of vocational education, integrate digital skills into the vocational capacity building system and put it into practice, cultivate more high-quality technical skills personnel with "digital skills"[4, 6], so as to effectively promote the high-quality development of the digital economy. The high level major group of computer application technology in our school, in line with the current trend, will make corresponding optimization of talent training objectives to make it fit the trend of digital economy development, which will be our key task in the next few years[5, 9, 11].

2. Computer application technology major group formation background

Our school is located in Dongguan, located in the core area of Guangdong, Hong Kong, Macao and the Great Bay Area. When declaring the provincial high-level professional construction project, we comprehensively consider the situation of regional economic construction and development trend, and set up a Major Group of computer application technology to connect with the vocational job groups of the new generation information technology industry chain of electronic information in Guangdong, Hong Kong, Macao and the Great Bay Area, which includes computer application technology, computer network technology, software technology, Internet of things application. The major group includes 5 majors of computer application technology, computer network technology, software technology, Internet of Things application technology and big data technology, cultivating and developing new service industry, accelerating the integration of intelligent terminal products with big data, Internet and Internet of Things, and serving the development of regional digital economy[7-8].

It is planned that after a five-year project construction period, the focus will be on creating high-quality practical teaching conditions for new generation engineering majors such as mobile Internet, Internet of Things, cloud computing, big data and artificial intelligence, building an electronic information teaching platform based on new generation information technology, and cultivating intelligent terminal technology talents in the information technology industry. We strive to achieve effective construction of computer application technology Major Group in talent training mode, curriculum teaching resources construction, teaching materials and teaching method reform, teachers' teaching innovation team, practical teaching base, technical skills platform, social services, international exchange and cooperation, sustainable development guarantee mechanism, etc[10].

2.1. Formation logic of major group

The overall principle of grouping logic of high-level majors in computer application technology is to form Major Group according to the principle of "similar foundation, similar technology, related jobs and shared resources". The internal logic of the industry chain determines the logic of the majors in the cluster, delineates the boundary of the majors in the cluster, gives full play to the advantages and driving role of the core majors, and provides guarantee for maximum resource sharing. As the leader of the whole industry chain of new generation information technology mobile Internet, it is decided that the innovation of its technology can promote the change and development of the industry chain, so this Major Group takes the computer application technology major with the closest cooperation with the hair enterprises in Guangdong, Hong Kong and Macao Bay Area as the core major. The core profession fits the leading enterprises of the industry chain, can quickly reflect the changes and development of the industry chain, play the driving and leading role of the core profession, and is more conducive to the Major Group to cultivate a new generation of information technology talents suitable for market demand. With computer application technology as the core of Major Group, its professional basic courses can be expanded into Major Group platform courses, which is conducive to the construction of "broad-based and live module" according to the idea of "Major Group platform courses + professional core courses + job course modules". The Major Group curriculum system can promote the Major Group curriculum system to achieve "bottom-level sharing (Major Group platform courses), middle-level separation (core courses of each profession within the group) and high-level interoperability (job course modules)", so as to maximize the sharing of resources.

Firstly, the majors in the cluster are highly related and support each other. From the analysis of professional fields, the five majors belong to the computer class of electronic information category, with similar professional bases and technical fields. From the analysis of professional positions, the positions of Major Group are closely focused on the technical fields of software and mobile application development, big data and cloud computing, network management and security in the "mobile Internet industry chain", and the professional positions are complementary and highly related.

Secondly, there is a high degree of sharing of professional teaching resources within the cluster. Teaching resources such as public platform courses, on-campus and off-campus training bases, curriculum resources and scientific research platforms of
professions are shared. The five majors unify to offer four Major Group platform courses such as "Programming Basics", "Database Technology and Application", "Computer Network Technology Basics" and "Linux Operating System Application"; the sharing degree of on-campus and off-campus practical training bases within the Major Group reaches more than 70%; course resources are built and shared collaboratively, scientific research platforms are open and shared, and resources such as professional teacher teams, practical training sites, student workshops, examinations and competitions in the professional clusters, there is mutual integration, interoperability, mutual recognition and mutual use, and teachers and students collaborate and innovate to carry out product development and technical services to jointly improve the quality of talent training, as shown in Figure 1.

2.2 Major group dovetail industry chain

The mobile Internet application industry chain driven by the new generation of information technology has a huge application market. Among them, the downstream industry chain does not need to have a profound theoretical foundation, and there are many professional and technical positions for higher vocational students. This Major Group is led by computer application technology and Internet of Things application technology, and supported by software technology and big data technology. Chain and innovation chain create a highland for training mobile Internet application talents and serve the economic development of the Guangdong-Hong Kong-Macao Greater Bay Area.

The mobile Internet application industry chain driven by the new generation of information technology has a huge application market. Among them, the downstream industry chain needs more high-quality technical and technical talents, and has a large number of vocational positions for higher vocational students. This Major Group is led by computer application technology, supported by computer network technology and Internet of Things application technology, and featured by software technology and big data technology. Chain, build a comprehensive talent training highland for the "design-development-test-operation and maintenance" posts of the new generation of information technology industry, and serve the development and construction of the Guangdong-Hong Kong-Macao Greater Bay Area.

2.3 Major group dovetail with occupational job groups

Computer application technology and software technology majors are aligned with "Web application software, enterprise information development" and other mobile Internet application front-end and back-end development and technical support services. Computer network technology, Internet of Things application technology and big data technology majors are aligned with "network management and security, Internet of Things, cloud computing, big data" and other mobile Internet basic support technology and operation and maintenance services. Around the "mobile Internet industry chain" subdivision job chain, Major Group positioning classification training "design - development - testing - operation and maintenance" and other four types of high-quality technical skills personnel.

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Computer application technology Major Group in accordance with the "job sharing, collaborative services, efficient application" concept, Major Group talent training positioning to the mobile Internet industry chain career positions computer application technology and software technology professional to "Web application software, enterprise information development "The front-end and back-end development of mobile Internet applications and technical support services. Computer network technology, Internet of things, big data technology majors are aligned with "network management and security, Internet of things, cloud computing, big data" and other mobile Internet basic support technology and operation and maintenance services. Around the "mobile Internet industry chain" subdivision of the middle and lower reaches of the job chain, the Major Group positioning classification training "design - development - testing - operation and maintenance" and other four types of high-quality technical skills personnel. Corresponding career positions are:

(1) Design positions: cloud system architecture, UI design, database design, wireless LAN planning, IoT system architecture;
3. Major group building programs

The computer application technology Major Group connects with the professional post group of the new generation information technology industry chain of electronic information in the Guangdong-Hong Kong-Macao Greater Bay Area, cultivates and develops emerging service formats, and accelerates the integration of smart terminal products with big data, the Internet, and the Internet of Things. During the construction process, it is planned to carry out the construction from the following aspects to improve the construction effect of the Major Group of computer application technology.

3.1 Reform of teachers, teaching materials and teaching methods

3.1.1 Innovation in Talent Training Model

Strengthen the school-enterprise dual education, use the school-enterprise co-construction studio as the carrier to introduce enterprise projects, carry out talent training based on engineering education, closely cooperate with enterprises in the Greater Bay Area, and actively cooperate with Huawei Network Technology Co., Ltd. and Huike Education Technology Group Co., Ltd. The company and many other well-known enterprises have carried out school-enterprise cooperation, promoted the construction of Huawei ICT College and Industry College, actively explored the reform and innovation of the talent training model for Major Group, and established a collaborative education system based on the school-enterprise dual system. In the process of talent training, actively Promote the reform and practice of "three comprehensive education". Through the construction of Huawei ICT Academy, Industry Academy and other projects, we will actively introduce more high-quality enterprises. According to the characteristics of the enterprise, the trend of new technologies and the needs of professional construction and development, a new school-enterprise co-construction studio will be established. Attract more outstanding students to join the studio, use the studio as a carrier, continue to promote reform practice, build a school-enterprise joint construction, build a school-enterprise dual collaborative education system, and jointly promote the realization of full-time education for all employees and whole-process education. People, all-round education.

3.1.2 Course teaching resource construction

Firstly, build "shared and open" teaching resources. Teaching resources of Major Group are built according to the idea of "Major Group platform courses + professional core courses + job module courses" to realize "sharing at the bottom, separation at the middle and interoperability at the top". At the same time, promote the pilot work of "1+X" certificate, carry out the reform of curriculum system, integrate the content of X certificate in the professional curriculum system, complete the reform of 4 Major Group platform courses and build 7 job module courses. Promote the reform of "curriculum thinking and politics", and integrate ideological and political education in the reform and construction of professional courses of each major. For the Major Group platform courses, build online open courses and promote the construction of digital resources. In the construction of resources for "1+X" related courses, we actively cooperate with enterprises to build 3 to 5 high-quality course resources according to the standard of X certificate.

Secondly, develop project-based courses and supporting teaching resources for engineering integration. Relying on the workshops jointly built by the school and enterprises, the curriculum is integrated with the main line of students' ability cultivation and the axis of vocational skills training and job knowledge strengthening. Develop high-quality core courses for professional clusters according to the logical requirements of professional learning areas; develop professional theory courses with industry typical cases as the carrier to sequential knowledge elements, and develop professional practical training courses to highlight key technical task-driven and professional skill requirements.

3.1.3 Teaching materials and teaching method reform

Reform the traditional teaching methods and teaching means, establish a student-centered and student-oriented project-based teaching model that is oriented to professional needs and focused on practical ability cultivation. Continue to promote the construction of project-based tutorials and modularized teaching materials for mobile Internet platforms in design and development, testing, operation and maintenance, and application enhancement. Prepare high-quality specialty platform teaching materials, promote pedagogy reform with information technology, and steadily push forward the reform work of more than 6 specialty core courses for the construction of specialty groups to carry out project-based teaching. At the same time, relying on the workshop, the school-enterprise "double tutor" system is promoted to carry out co-teaching and improve students' vocational ability. During the construction period of the Major Group, 5 to 8 project-based and loose-leaf
teaching materials will be written and published jointly with enterprises.

3.1.4 Innovation of teaching team

Firstly, improve the mechanism of faculty construction, accelerate the systematic training of faculty, adopt the way of school-enterprise cooperation, internal training and external attraction, and build the faculty of Major Group based on the open principle of "school teachers go out and industry experts come in". Introduce high-end technical talents from new generation information technology enterprises, famous engineers and skill masters into the school part-time, enrich the existing Major Group teachers and improve the structure of the teachers.

Secondly, using the existing conditions of the school and the official teacher training system of Huawei ICT Academy, 1-2 young key teachers are selected each year to participate in teacher training in the technical direction of digital communication and cloud computing, and obtain Huawei Certified Academy Instructor Certificate (HCAI). Combined with the teaching needs of 1+X certificate related courses, 2-3 young backbone teachers are selected and sent each year to participate in the teacher certification of X certificate to improve the teacher level of the Major Group.

Finally, carry out systematic training of full-time teachers on campus to improve their business level and strengthen enterprise practice. Ten backbone teachers are selected for enterprise practice and 20 are selected to attend domestic training conferences related to new-generation information technology, and young teachers are encouraged to upgrade their education and master the frontier technology of new-generation information technology. At the same time, we support professional leaders to participate in activities of industries, associations and societies, send professional leaders to participate in academic exchanges at home and abroad and visit and exchange with advanced universities in China to activate the professional ability of professional leaders.

3.2 Practical teaching reform

3.2.1 Practical teaching bases

Actively build Major Group shared bases, according to the development trend of new generation information technology, Major Group construction and the needs of talent training, increase investment and implement upgrading projects for the existing bases; combine with the needs of students' off-campus practical teaching, increase contact with cooperative enterprises, increase investment and build more perfect provincial off-campus practical teaching bases. Combined with the "Internet Industry College" and other construction projects, we will promote the construction of new technology training bases such as cloud computing, big data and artificial intelligence, and plan to invest 7 million yuan to build a perfect training practice place for the training of new generation information technology talents.

3.2.2 Technical skills platform

Actively implement the technical skills platform construction of this Major Group, and jointly carry out practical teaching platform and technical skills certification platform with enterprises to improve students' professional core competitiveness. According to the information technology industry on Web application development, cloud computing, big data, Internet of Things direction application positions to build technical skills platform in line with the needs of local industries, plans to invest 1.1 million yuan.

3.3 Cooperation with external parties

3.3.1 Formatting the title

Utilize the practical teaching conditions of the Major Group and the high-quality and high-level teaching staff to carry out training services such as cloud computing, big data, and the Internet of Things for the society, and provide a new generation of information technology talents for the information technology industry to serve the economic construction of the Guangdong-Hong Kong-Macao Greater Bay Area. At the same time, use the studio to build an excellent student team, led by key teachers, and cooperate with enterprises to carry out website development, testing, operation and maintenance and other related horizontal project construction.

3.3.2 International exchange and cooperation

Organize students to participate in cooperation projects with counterparts in overseas institutions, promote credit recognition and course replacement, realize technical talents in line with international standards, and encourage students to participate in activities such as outbound exchanges, learning, and training.

3.4 Guarantee Mechanisms

A leadership group is established at the university level to provide organizational, institutional, financial and other guarantees, to build a dynamic optimization system for professional settings of professional clusters, and to dynamically optimize resources within professional clusters based on talent demand and graduate employment quality tracking; to establish a complete and relatively independent self-quality assurance mechanism at different levels of teaching management, majors, courses, teachers and students, and to form an all-factor, networked, full-coverage, strong early warning and incentive internal quality assurance system; to establish a professional accreditation system with the goal of building an evaluation mechanism and quality standards of international standards, and to establish educational quality norms with continuous improvement effects.
4. Implementation of major group construction

After nearly two years of construction, the computer application technology Major Group around the requirements of the new era of vocational education, optimize the Major Group talent training objectives, dovetail with the new generation of information technology industry chain of electronic information in the Guangdong-Hong Kong-Macao Bay Area and the emerging digital economy industry chain. Now the Major Group has a total of 3222 students, 121 full-time and part-time teachers from enterprises, and 267 courses in FY2021 and FY2022, including 67 practical training courses, with part-time teachers from enterprises undertaking the teaching tasks of 57 courses. In the process of implementation, the construction tasks of talent training mode innovation, curriculum teaching resources construction, textbook and teaching method reform, teaching innovation team construction, practical teaching base construction, technical skills platform construction, social service, international exchange and cooperation and sustainable development guarantee mechanism construction have been completed in the corresponding two years, and certain achievements have been made mainly in the following aspects.

4.1 Exploration and practice of the construction of professional clusters

4.1.1 Talent training model innovation

Introduce high-quality enterprises, build industry colleges, set up professional construction steering committees with the deep participation of industries and enterprises, and explore the "double main body, two integration and diversification" talent training mode. Grasp the development trend of industry, aim at the frontier technology of industry, fully integrate the elements of industry, industry, enterprise, occupation, practice, etc., joint industry enterprises to scientifically develop talent training programs. Actively carry out joint school-enterprise enrolments, joint training of modern apprenticeship talent training model pilot, innovative school-enterprise integrated education model reform. Schools and enterprises cooperate in formulating talent training programs and curriculum standards for professional clusters, actively carry out school-enterprise collaborative education practices, and integrate teaching standards and teaching contents into vocational skill level certificate requirements.

4.1.2 Teaching resources construction of major group platform courses

The Major Group teaching resources build a Major Group course system in accordance with the idea of "Major Group platform courses + professional core courses + post module courses" to realize "bottom-level sharing, middle-level separation, and high-level intercommunication". The construction of open and shared teaching resources for professional courses fully reflects new technologies, new processes, and new norms in the industry. The specific platform curriculum settings are shown in Table 1.

<table>
<thead>
<tr>
<th>Serial Number</th>
<th>Course Title</th>
<th>Course Code</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Programming Basics</td>
<td>MB019003</td>
</tr>
<tr>
<td>2</td>
<td>Fundamentals of Computer Network Technology</td>
<td>MB019001</td>
</tr>
<tr>
<td>3</td>
<td>Database Technology and Application</td>
<td>MB019002</td>
</tr>
<tr>
<td>4</td>
<td>Linux operating system application</td>
<td>MB019008</td>
</tr>
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4.1.3 Teaching materials and teaching method reform

Combined with the requirements of the document "National Vocational Education Reform Implementation Program", each major in the Major Group actively promotes the reform of "three full education" to realize "full education, full education and full education". At the same time, in the reform construction of the professional curriculum of each major, we actively promote the reform of "curriculum thinking and politics", integrate ideological and political theories with professional teaching, and achieve a high degree of integration of vocational skills and professionalism. In the teaching process, we emphasize student-centeredness, focus on the application of information technology, reform teaching methods and evaluation methods, and promote the classroom revolution. The school and enterprises cooperate and jointly develop teaching projects with VET characteristics, loose-leaf teaching materials, school-based teaching materials and other resources. In the past two years, we have published "Fundamentals of Computer Network Technology (Microlearning Edition)” and "Linux Application Fundamentals Project-based Tutorial (RHEL8.2 & CentOS8.2)”, a total of four professional teaching materials.

4.1.4 Construction of teaching team

Through internal training and external attraction, a high-level and structured teacher teaching innovation team is formed. At the same time, it establishes a mechanism for classifying and training teachers within a cluster of majors, and carries out teacher training for the characteristics of different majors. Actively explore the modular teaching mode of teachers' division of labor and collaboration. Actively introduce all kinds of outstanding talents and raise the ratio to 70% in terms of dual-teacher teachers and 40% in terms of part-time teachers from enterprises to teach in professional courses and practical courses.

4.1.5 Construction of practical teaching base

Through the integration and optimization of resources, the school has coordinated the planning and construction...
of on-campus and off-campus practical training bases, and actively explored to enhance the openness and sharing of practical training bases and the integration of industry and education. The school has completed construction projects such as the comprehensive practical teaching base of artificial intelligence and the Internet Industry College, and has now declared three provincial-level off-campus practical teaching base construction projects for college students. The school has vigorously promoted Major Group construction projects and added five new on-campus practical teaching bases for cloud computing, big data and artificial intelligence.

4.1.6 External cooperation and exchange and services

The school has built one Industry-Academia-Research Center, and the cumulative funding for various vertical and horizontal projects has reached 250,000, built two research teams, applied for and was approved six provincial textbook research projects, applied for patents and soft literature, and was approved 15, including four invention patents, published 36 academic papers, including four AMI papers, seven EI papers, two SCI papers, and seven CPCI papers to be retrieved.

Carry out technical services to effectively improve production efficiency, product quality and service quality; carry out various forms of training for highly skilled personnel in areas that are in urgent need or shortage in the regional economy and society. Take the initiative to open school resources for the region, realize the common construction and sharing between schools and localities, and complete 2,300 person-times training of new generation information technology skills in Huawei ICT and other aspects jointly with enterprises.

4.2 Exploration and practice of 1+X certificate

Taking the implementation of "1+X" certificate system pilot as an opportunity, each major combined with the characteristics of the major to carry out the pilot of the corresponding X certificate, and combined with the requirements of the junior, middle and senior certification system, reconstruct the curriculum system of each major in the cluster, realize the organic docking of vocational skills level certificate and course teaching content, and use the X certificate system to achieve the purpose of clarifying career development paths for students. In the past two years, the following three ways of exploration and practice have been carried out.

4.2.1 Integration of course and certificates

For the primary examination of "Java Web" certificate, the reform practice is carried out in computer application technology, software technology and other majors, and the official textbook of the corresponding certificate is selected as the teaching material of the corresponding course, and the teaching is carried out in a way that the course and the certificate are integrated in the classroom teaching.

4.2.2 Integration of Graduation and Professional certificates

For the advanced certificate of "X Certificate", "IOT Intelligent Terminal Development and Design" vocational skill level certificate is selected as a pilot practice in the IOT application technology major. The reform practice of "book and certificate integration" is carried out in the process of professional personnel training, and the content of the advanced certificate examination is integrated into the whole teaching process of the major and scattered into the teaching of courses in each semester. After students pass the relevant courses before graduation, in the 5th or 6th semester, more than half of the students can obtain the advanced certificate of this certificate after passing the official examination.

4.2.3 Integration of post-course competition certificate

The computer application technology majors have a large number of students, and in the experimental class and excellence class, the practice of "post-course-competition-certification" for the certificate of "Web front-end development" is carried out to systematically cultivate compound and skilled technical talents. The details are shown in Figure 2.

5. Conclusion

The digital economy is the future trend, and the shortage of talents in related industries is already foreseeable. In the process of building a high-level major group of computer application technology in our school, we should combine this trend and optimize the corresponding construction goals. Judging from the current situation of the facilities built by major groups, these explorations and practices are conducive to improving the quality of talent training in the digital economy, improving the ability of the professional service industry, improving the ability of schools to serve the regional economy, and improving the quality of schools. It can provide reference for the construction of other similar projects.
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