CULTIVATION MODEL OF PROFESSIONAL DEGREE GRADUATE STUDENTS INTEGRATING INDUSTRY AND EDUCATION UNDER BACKGROUND OF "NEW ENGINEERING"

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ABSTRACT

Due to the weak practical ability, insufficient innovative spirit, and weak professional awareness in the current professional degree graduate student education, this paper has conducted the study on the joint cultivation of the professional degree graduate student integrating the industry and education under the background of the "new engineering". It has established the cultivation model of the professional degree graduate student with the industry-education integration and collaborative education. Guided by the national major strategies and the economic and social development needs of the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), the universities, enterprises and governments fully coordinates and cooperates with the cultivation of the high-level engineering talents and scarce talents, which is able to comprehensively improve the practical innovation ability of the professional degree graduate students, and enhance the market recognition of the engineering education, thereby promoting the sustainable development of the engineering education under the background of the "new engineering".

KEYWORDS

Professional Degree Graduate Student Education, Industry-education Integration and *Collaborative Education, Joint Cultivation Model, "New Engineering"*

1. INTRODUCTION

With the increasingly obvious innovation-driven development, the speed of the fourth industrial revolution is growing exponentially, which poses the new requirements for the development of the higher engineering education and the cultivation of the engineering and technological talents (Hadek et al., 2019; Geng et al., 2020; Barnes et al., 2020; Ntinda & Ngozwana, 2021). Due to the fact that traditional engineering education may not be able to meet the demand for the engineering and technical talents in emerging economic development, the education department has begun to vigorously develop and explore the construction and development of the "new engineering" (Xie et al., 2021; Xie et al., 2022), from "Fudan Consensus" (Ministry of Education, 2017a) to the "Tian Da Action" (Ministry of Education, 2017b), and then to the "Beijing Guide" (Ministry of Education, 2017c), which has pointed out the reform direction and course of the action for the higher engineering education under the new situation. Five news points were pointed out (Shang et al., 2019), mainly including establishing the new engineering education concepts, constructing the new disciplinary structures, exploring the new models of the talent cultivation, establishing the new system of the classified development, and creating the new educational and teaching quality (Wen, 2021). The proposal of the innovative concept of the "new engineering" has put forward the higher requirements for the higher engineering education

and the cultivation of the engineering science and technology talents. It requires the engineering majors to focus on cultivating the high-quality talents with the good basic scientific literacy, engineering innovation spirit, and solid experimental foundation. Only with the high comprehensive experimental quality can they engage in the basic and applied research (Shang et al., 2019; Yuan et al., 2019).

The professional degree graduate student education, as the main battlefield for cultivating the high-level applied talents, is playing an increasingly important role in the graduate education and training system. “2021 Work Points of the Higher Education Department of the Ministry of Education” (Ministry of Education, 2021) clearly points out that we need to comprehensively deepen the construction of the “new engineering” disciplines and accelerate the cultivation of the high-level and scarce talents in engineering majors. Explore and summarize the engineering education concepts that are in line with China's actual situation, and continuously deepen the innovation of the industry-education integration and collaborative education models. The professional degree graduate education has the unique advantages in adapting to the adjustment of the industrial structure and the diversified demand for the talents in the development of the emerging industries. Therefore, it is necessary to attach the great importance to the professional degree graduate education. This requires us not only to accelerate the cultivation of the professional degree graduate students, but also to cultivate the high-quality engineering and technical talents that meet the needs of the motherland and the people. Besides, we need to innovate the training models, promote the integration of the industry and education, shift from one party leading to the multi-party collaboration, and then usher in a new stage of the connotative development of the professional degree graduate education. Finally, we fully implement the important instructions of the National Conference on the Graduate Education, achieve the high-quality development of the professional degree graduate education, support and lead the economic and social development, and then serve the construction of a socialist modernized strong country. For the cultivation of the professional degree graduate students, the new era has put forward the new requirements and challenges. How to deepen the construction of the “new engineering” disciplines and accelerate the cultivation of the high-quality and high-level engineering talents is an urgent problem that needs to be solved, and the further in-depth thinking and research are needed (Luo et al., 2018; Fan & Tian, 2021).

However, compared with the rapid scale development, the professional degree graduate students still face some problems such as the weak practical ability, insufficient innovative spirit, and weak professional awareness, thus the market awareness and recognition of the professional degree graduate education are clearly insufficient. The root cause lies in the fact that universities, enterprises, and governments act independently among other training entities, and lack a long-term mechanism for the collaborative training. The responsibilities of each entity in the training process are not clear, the government's macroeconomic regulation and guidance role is lacking, and the participation of the enterprises is not high or deep enough. The talent cultivation of the universities and the effective demand of enterprises are disconnected from each other at the supply and demand level, and the training goal of engineering and technology applied talents cannot be achieved. Therefore, it is urgent to explore the collaborative education model and mechanism of the industry-education integration to promote the participation of the industry innovation resources in the joint training of the professional degree graduate students under the new forms, like the background of the “new engineering”.

The joint cultivation model of the professional degree graduate student integrating the industry and education under the background of the “new engineering” has been proposed in this paper. Section 2 introduces the joint cultivation model of the professional degree graduate student integrating the industry and education. The implementation effect and reflection of this mode is proposed in Section 3. Finally, a conclusion is given in Section 4.

2. JOINT CULTIVATING MODEL OF PROFESSIONAL DEGREE GRADUATE STUDENT INTEGRATING INDUSTRY AND EDUCATION

For the problems and challenges faced in the cultivation of the professional degree graduate students, Sun Yat-sen University plans to build a professional degree graduate training model integrating the industry and education, guided by national major strategies, economic and social development in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), and enterprise requirements. This model aims to improve the practical and innovative abilities of the graduate students, establish the "Trinity" training community, adopt the "Three-layer progressive"comprehensive training method, and take the "Five commonalities" as an important measure, aiming to achieve the connection between the education chain, talent chain, industry chain, and innovation chain, and ultimately achieve the goal of coordinating and cooperating with the universities, enterprises, and governments to jointly cultivate the high-level engineering talents. This model is conducive to mobilizing the enthusiasm of the universities, enterprises, and governments to participate in the entire process of the talent cultivation, and effectively improve the quality of the high-level engineering talent cultivation, thus the cultivation effect is widely recognized by the industry and society. For the cultivation of the professional degree graduate students from other industry backgrounds, it also provides the reference and inspiration.

2.1. Focusing on a Core Goal

Enhancing the practical innovation ability of the professional degree graduate students can not only improve the quality of the talent cultivation in universities and the technological innovation ability of the enterprises, but also meet the demands of the government to promote the social and economic development, align with the common interests of all training subjects, and is the core goal of promoting the collaborative cooperation among the universities, enterprises and governments. The universities, enterprises and governments can jointly enhance the practical innovation ability of the professional degree graduate students through the joint demonstration of the training programs, joint demonstration of the curriculum systems, flexible use of teaching methods, and joint implementation of the professional practice.

(1) Joint demonstration of the training programs

The joint evaluation system for the training programs among the universities, enterprises, and governments should be implemented. Guided by the economic development, enterprise development needs, and engineering talent quality standards of the Guangdong-Hong Kong-Macao GBA, and referring to the guiding opinions of the education guidance committees at all levels on the training programs, we will hire members of the education guidance committees, enterprise experts, experts from universities in the Guangdong-Hong Kong-Macao GBA, and experts on campus to jointly discuss and determine the training objectives, curriculum systems, and teaching methods, in order to establish a distinctive training program for the professional graduate students that deeply integrates the basic theory with the enterprise practice. By adopting a combination of the course learning, professional practice, and degree thesis training methods, we aim to fully integrate the latest practical achievements of the enterprises with the professional theoretical teaching. This not only highlights the cultivation of basic engineering or practical qualities, but also strengthens the basic education in engineering knowledge, practical knowledge, engineering ethics, and professionalism. It also highlights the cultivation of the engineering technology research and innovation qualities, and strengthens the cultivation of the exploration spirit, which can encourage graduate students to actively participate in the research on the engineering practice projects from enterprises, and effectively enhance their practical and innovative abilities. An evolutionary model has been adopted to timely revise the training plan,

which can optimize the curriculum system, and adapt to the needs of cultivating the high-end applied talents in the new era.

(2) Joint demonstration of curriculum system

The joint demonstration system among the universities, enterprises and governments in the curriculum system should be implemented. Experts from the universities, enterprises, and government departments jointly study the curriculum system based on the requirements of the professional degree graduate students' ability and quality according to the training objectives. They follow the principles of "the correct ideological and political thinking, qualified social responsibility, solid theoretical methods, and excellent technical application", and demonstrate the necessity of the curriculum design from the aspects of the goal positioning, applicable objects, curriculum content, teaching staff, teaching design, assessment methods, expected effects, which can ensure the quality of course offerings. The specialization and systematization of curriculum design has been emphasized to enhance the professional competence and basic skills of graduate students. According to the changing demand for the engineering knowledge in economic development and industrial upgrading, the curriculum system and teaching methods are regularly adjusted to ensure the forefront and practicality of the curriculum, achieve the optimization of the engineering knowledge learning, professional skills training, and practical experience accumulation, which improves the practical innovation ability of graduate students.

(3) Flexible application of teaching methods

The goal is to cultivate the practical innovation ability of the graduate students, with the solid foundation in the engineering, improving the professional skills and comprehensive literacy as the core, and exploring the teaching methods and approaches that are in line with the characteristics of engineering talents. The problem-based teaching is advocated, the teaching methods such as case-based, interactive, and heuristic approaches are introduced, which can integrate the theory and practice, knowledge and skills, and align the graduate engineering practice with the social needs. The practical application courses are offered, the enterprise experts and off-campus mentors are employed to strengthen comprehensive training, simulation training, and innovation training through the case studies, project teaching, on-site teaching, or simulation training, which can emphasize the cultivation of the graduate students' application design and innovative experimental abilities. We should encourage the graduate students to participate in the graduate innovation practice series competitions such as electronic design competitions, mathematical modelling competitions, and intelligent robot competitions, which can conduct the professional research through the subject competitions to achieve the goal of promoting the learning through competitions.

(4) Joint implementation of professional practice

Making the professional practice a compulsory component. The professional practice is carried out through two methods: combining on-campus and off-campus, and combining concentration and segmentation. The off -campus mentors from enterprises are the main responsible persons for the professional practice, which should create conditions for the graduate students they guide to carry out the practical activities related to their thesis, and emphasize the cultivation of the graduate students’ awareness and ability to solve practical problems in practice. By absorbing and utilizing the social resources, a practical teaching system that combines on-campus module training and off-campus professional practice is built, which can provide and guarantee the conditions for the conducting practical training. Besides, closely integrating with the economic development needs of the Guangdong-Hong Kong-Macao GBA, using engineering projects and management cases as the carriers, an on-campus practice module guided by industry enterprise

source projects is constructed. We have conducted extensive and in-depth cooperation with the state-owned large and medium-sized enterprises, private enterprises, and government departments, and can cooperate to build provincial-level off campus practice bases. Guided by the scientific research projects, we can collaborate with the renowned universities in the Guangdong-Hong Kong-Macao GBA, such as the Harbin Institute of Technology (Shenzhen), Chinese University of Hong Kong (Shenzhen), Hong Kong Baptist University (Zhuhai), and University of Macau (Zhuhai), to jointly cultivate the professional degree graduate students.

2.2. Building a "Trinity" Training Community

The cultivation of professional degree graduate students is a systematic and complex scientific system. Universities need to actively connect with the economic and social development and the professional needs of enterprises, follow the principles of "Complementary advantages, resource sharing, and talent cultivation", coordinate and cooperate with the enterprises and government departments, clarify the relationship between the training subjects, establish and improve the organizations and institutional guarantees, and build a "trinity" training community guided by the government, cantered on universities, and supported by enterprises, which ensures the implementation of multi subject collaborative training.

(1) Play the guiding and coordinating role of the government

The government is the guide, coordinator, and guarantor of the professional degree graduate education. First, it should give fully leverage the macro guidance, coordination, and supervision functions of the education administrative management department, strengthen top-level design, introduce the policies and regulations related to professional degree graduate education, increase the funding investment, support the establishment of the projects related to the professional degree graduate education reform, and provide relatively complete the institutional guarantees and financial support for the school-enterprise joint training. Besides, it should guide the universities and enterprises to actively participate in the professional degree graduate education, improve the coordination and supervision mechanisms, promote the effective communication and deep cooperation between the schools and enterprises, promote the coordination and cooperation mechanisms among multiple entities, enhance the practical and innovative abilities of graduate students, and ensure the quality of the graduate education. Finally, it fully leverages the coordinating and supervisory role of the local governments, guided by the economic development needs of the Guangdong-Hong Kong-Macao GBA, and led by local governments, to attract schools and enterprises to jointly build the joint training bases. The government departments are responsible for providing the basic management functions such as the food and accommodation, project release, to repair and bridge the differences caused by the excessive emphasis on competition between the schools and enterprises, and to focus on applied research characterized by project cooperation, which can improve the quality of the talent cultivation and technological innovation capabilities, and provide the human and intellectual support for the regional economic development.

(2) Give full play to the core role of universities as the main body

The universities are the core body of the professional degree graduate training, and also the implementers of the educational and teaching reforms. First, under the macro guidance and coordinated supervision of the education policies by the government departments at all levels, the universities and enterprises, as well as the government, have formed strong alliances by establishing on-campus and off-campus practice bases and hosting a series of innovation and entrepreneurship competitions, integrating practical problems of enterprises into the curriculum learning, professional practice, and research projects, attracting enterprises to participate in the

talent cultivation in all aspects. Besides, the universities host various graduate competitions, which exercise the ability of the graduate students to solve practical problems, enhance the technical level and educational enthusiasm of the enterprises, strengthen the communication and cooperation between universities, which can achieve a win-win situation of “learning through competition, production through competition, and cultivation through competition”. At last, the education department can regularly convene the expert committee members from schools and enterprises to jointly discuss the major issues related to the construction standards of the case libraries, form and standards of dissertations, and evaluate the provincial demonstration courses and case library construction projects, provincial practice bases, and provincial excellent professional master's theses. It is necessary to strengthen the communication and cooperation with the government education departments and enterprises, improving the quality of the professional degree graduate training.

(3) Play the supporting role of enterprises as the main body

Enterprises are the main support for cultivating the professional degree graduate students. First, it needs to change its mindset, actively participate in the entire process of the talent cultivation by providing the technology, funding, and management resources, collaborate with universities to establish the off-campus practice bases, improve the talent quality by solving the practical problems, promote the technological innovation and industrial upgrading, and promote the full integration of the talent cultivation in universities and effective industrial needs. Besides, it should actively encourage technical backbone to serve as off-campus mentors for the enterprises, transform urgent production technology problems into scientific research projects, carry out the long-term project research and development cooperation with the university mentors, and strengthen the construction of the dual teacher mentor teams. Finally, it should establish the practical positions based on projects, collaborate with two mentors to cultivate graduate students, jointly develop the training plans, guide the professional practice and research projects, evaluate the practical effects and training quality. It not only improves the practical innovation ability of graduate students, but also solves the production difficulties of enterprises, improves the level of technological innovation of enterprises, enhances the internal drive to participate in the talent cultivation, and can solve the problem of “last mile” enterprise technological innovation and university talent cultivation.

2.3. Adopting a “Three-Layer Progressive” Fusion Cultivation Method

The traditional training model generally involves graduate students first studying courses on campus and then participating in the professional practice off campus. The theoretical learning and professional practice are usually simply overlapping and disconnected, which is not conducive to cultivating the graduate students' practical and innovative abilities. This project adopts a “three-layer progressive” integrated training method, which is divided into three stages: on-campus curriculum learning, off-campus professional practice, and thesis writing. The evolutionary model of "Problem-solving, knowledge acquisition, and problem-solving” is adopted to achieve a progressive integration of theory and practice. The theoretical learning is enriched with practical content, guided by theoretical learning to professional practice, and the theoretical level is improved with the practical experience, which can promote the spiral and progressive evolution of the engineering knowledge, consolidate the engineering knowledge foundation of the graduate students, and enhance their practical and innovative abilities.

(1) On-campus course learning stage

First, it should set up the course content and teaching methods based on the needs of enterprises, add the engineering practice courses, carry out the case teaching, invite the technical backbones

of enterprises to undertake the teaching tasks, integrate the new technologies, new processes and new methods of enterprises, and enhance the practicality and progressiveness of the professional theories. Besides, it should integrate the on-campus experimental platform resources, construct the on-campus practical modules through enterprise sourced projects, synchronize the on-campus course learning with the on-campus module practice, arrange the on-campus mentors with the rich engineering backgrounds to guide the on-campus practice of graduate students, and enrich their engineering experience. Finally, it should guide the campus practice with the professional theories, verify the professional theories through the practical experience, and then achieve the first layer of the integration between theory and practice.

(2) Off-campus professional practice stage

The graduate students can choose to continue their research on practical projects on campus or delve into the actual research projects in enterprises, avoiding formality such as the visiting and observing. When graduate students encounter the technical bottlenecks during the process of participating in enterprise research projects, they can choose to take relevant theoretical courses within the school according to their own needs, or seek professional theoretical guidance from school mentors. Some practical courses and team courses with the strong engineering backgrounds can be taught on-site at the base, taught by a team of dual teacher instructors, to stimulate the graduate students' interest in learning and improve their hands-on abilities. Guided by advanced theories in the engineering practice, achieving the second level of the integration between theory and practice.

(3) Thesis writing stage

First, the graduate students study, summarize and elevate the engineering problems encountered in the on-campus training modules and off-campus professional practices through the personal summarization, research group discussions, and other methods. Besides, under the guidance of the mentor group, the principles, methods, and techniques for solving sublimated engineering problems will be the main content of the thesis, and the thesis writing and defines will be completed. Finally, the mentor group summarizes and organizes the new technologies and methods in the thesis, integrates them into the professional theoretical teaching through the case studies, improves the teaching effectiveness of the course, and enhances the interest of graduate students in learning. Improving the theoretical level through practical experience can achieve the third layer of the integration between theory and practice.

2.4. Implementing a “Five Commonalities” Important Measures

The project plans to implement the “Five commonalities” important measures, including jointly setting training goals, jointly building a curriculum system, jointly building a dual mentor team, jointly building a professional practice platform, and jointly building a quality assurance system, in order to achieve the goal of universities, enterprises, and governments jointly cultivating high-quality engineering and technical talents.

(1) Jointly setting the training goal

The universities, enterprises, and governments, with the core of the enhancing the practical and innovative abilities of the graduate students, jointly set the training goals for engineering degree graduate students (including the basic and graduation goals), transform the training goals into the feasible professional training standards, and cultivate applied talents and high-tech talents in the engineering field that adapt to the development of the new era's economy and society and the professional requirements of enterprises.

(2) Jointly building the curriculum system

The course learning is the link between the multiple subjects to achieve the connection, compatibility, and evolution of the engineering knowledge, which is the basic condition for the graduate students to smoothly engage in the application of the engineering knowledge and technological innovation and upgrading. First, the expert committee members from universities, enterprises, and government departments refine professional standards into curriculum modules and teaching objectives, determine the training directions based on the regional economic and enterprise development needs, and the characteristics of universities themselves. Besides, they jointly establish the modular curriculum system that includes professional theoretical courses, practical application courses, case courses, research methods courses, and interdisciplinary courses, according to the different training directions and objectives for the engineering degree graduate students. This clarifies the internal connection between theoretical learning or practical links and ability development, strengthens the basic theories, expands practical teaching, which can organically integrate the transmission of the engineering theoretical knowledge with the improvement of the practical innovation abilities. Finally, guiding and encouraging off-campus mentors, research institute teams, and university mentors to enter the classroom and then lead students in a teaching mode, achieving the synchronization between curriculum design, research topics, training objectives, and knowledge application.

(3) Jointly building the dual mentor team

A high-level mentor team is the main implementer of the healthy development of engineering education, which is an important guarantee for the quality of the professional degree graduate training. The “invite in, go out” strategy is adopted to build a dual teacher mentor team through multiple channels. First, it should actively introduce the on-campus mentors with the excellent theoretical and practical abilities, hire the experienced enterprise experts as off-campus mentors, and establish the mentoring team with the on-campus mentors as the focus and off-campus mentors as the auxiliary. Second, it should pay attention to the centralized pre-job training of the on-campus mentors, regularly select and send the on-campus mentors to the corresponding enterprises for the on-the-job training, provide them with the good engineering practical training conditions, and enhance the engineering practical ability of the on-campus mentors. Third, it should invite the newly hired off-campus mentors to participate in the job training on campus. Through the special reports, seminars, training sessions, and other forms, help the off-campus mentors clarify their responsibilities, understand the law and current situation of the engineering education, familiarize themselves with the engineering education process, and improve the theoretical and guidance level of off campus mentors. Finally, during the training process, relying on a solid foundation of the cooperation, in-depth emotional communication, and a well-designed system, we aim to achieve the complementary advantages and collaborative education between two mentors.

(4) Jointly building the professional practice platform

The professional practice platform is an important guarantee for improving the professional quality of graduate students with the professional degrees. The core goal is to cultivate the practical and innovative capabilities, with the government support, enterprise support, and university participation, to jointly build the professional practice platform that combines the on-campus training modules with the off-campus practice bases. This will achieve standardized, institutionalized, diversified, and differentiated construction of the practice bases, and cultivate the high-level applied talents with the industry backgrounds through specific enterprise source project research and development.

(5) Jointly building the quality assurance system

Establishing a scientifically reasonable and systematically effective quality assurance system is an important measure to improve the quality of the graduate education. The diversity of the professional degree graduate education entities determines that stakeholders such as universities, enterprises, and governments must update the management concepts, innovate management elements, clarify the scope of rights and responsibilities, highlight key links, collaborate to build a comprehensive and full process quality assurance system, effectively manage and supervise the training process of engineering degree graduate students, and ensure the continuous and stable improvement of training quality.

3. IMPLEMENTATION EFFECTS AND REFLECTION

School of Electronic and Communication Engineering of the Sun Yat-sen University was established in 2017, which is one of the important measures of "New Engineering" development strategy of the Sun Yat-sen University. It will better serve the country and society through the knowledge innovation, technology transformation, and talent cultivation. The Guangdong-Hong Kong- Macao GBA is a new generation of the information technology "Silicon Valley" in China, with the famous IT enterprises such as the Alibaba, Huawei, Lenovo, and Tencent. Our college is rooted in the Guangdong-Hong Kong-Macao GBA and will become an important incubation and talent training base for the "New Engineering" like the electronic information and communication engineering technology in the region.

Since the launch of the professional degree graduate training and education, the School of Electronic and Communication Engineering of Sun Yat-sen University has explored and practiced the professional degree graduate training model that integrates the industry and education with the full participation and support of enterprises and governments, relying on the construction of practical bases. The model has achieved good results, by aiming to improve the practical and innovative abilities of the graduate students, and build a "Trinity" training community, adopting a "Three-layer progressive" integrated training method and taking the "Five commonalities" as an important measure.

3.1. Construction of Practical Bases is Becoming Increasingly Perfect

Relying on large enterprise groups, high-tech enterprises, renowned schools, research institutes, and government departments in the Guangdong-Hong Kong-Macao GBA, we have collaborated to build the practical base platform that combines the internal and external factors, has the rich levels, and is led by the unique characteristics. Guided by the enterprise source projects and relying on the on-campus training modules, the on-campus practice bases have been built. Some school-enterprise joint training base have been jointly established, such as the "Sun Yat-sen University Huawei Intelligent Base Cooperation Base", "Huawei Joint Training Base", "Unicom Joint Training Base", "Pengcheng Laboratory Joint Training Base", "GBA National Innovation Centre Joint Training Base" and "Shenzhen Guangqi Joint Training Base", which can provide the effective support for conducting the on-campus practice and off-campus collaborative training model. By establishing the professional degree graduate training practice base, guiding the graduate students to carry out the research projects based on actual enterprise projects, the practical ability of the graduate students has been exercised and helping enterprises solve the technical problems. This has the demonstrative and leading role in the high-quality development of the practice base and the cross disciplinary training of the graduate students.

3.2. Significant Improvement in Practical Innovation Ability

In the last year, the more and more graduate students have entered the off-campus practice bases to participate in the enterprise technology transformation and service projects. Under the joint guidance of the on-campus and enterprise mentors, they have completed the professional practice and thesis writing, enhancing their practical and innovative abilities. The graduate students actively participate in the national innovation practice series activities organized by the Ministry of Education, as well as various competitions and projects organized by Guangdong Province, such as the National College Student Electronic Design Competition, National College Student Mathematical Modelling Competition, National College Student Integrated Circuit Innovation and Entrepreneurship Competition, "Internet plus" Undergraduate Innovation and Entrepreneurship Competition, National College Student Programming Competition, National College Student Mathematics Competition, "China Software Cup" College Student Software Design Competition, National Air Force Algorithm Challenge Competition, "Yat-sen Cup" South China University "Intelligent+" Innovation Competition. The total number of awards in all competitions is 131, including 5 international second prizes and 13 national first prizes. In the National College Student Mathematical Contest, a total of 46 awards were won, including 1 national first prize, 2 national second prizes, and 7 provincial first prizes. The breakthrough results in the National College Student Electronic Design Competition is achieved, which wins10 awards, including 2 national second prizes and 3 provincial first prizes. In addition, we have won the highest award (first prize special award) in the final of the 11th "China Software Cup" College Student Software Design Competition, and the second prize (second in the country) in the final of the National Air Force Algorithm Challenge Competition. The above achievements fully demonstrate the quality and level of the professional degree graduate education in the School of Electronic and Communication Engineering of the Sun Yat-sen University.

3.3. Significant Improvement in Quality of Graduates

Most graduate students with the engineering degrees work in industries such as the electronic information, communication engineering, artificial intelligence, internet, internet of things, software development, and the employers have the high satisfaction with the graduates. The internship and practical experience have enhanced the market competitiveness of the graduates, accounting for the large proportion of the factors influencing their employment and salary. Besides, most graduates stay in the practical units to work due to excellent practical assessments. For the School of Electronic and Communication Engineering of the Sun Yat-sen University, there are 16 doctoral graduates in 2023, of which 14 have already been employed (including 2 who joined the military), with an employment rate of 87.5%. There are also 35 master's degree graduates in 2023, of which 32 have been employed (including 1 who joined the military), with an employment rate of 91.43%.

3.4. Abundant Achievements in Serving Social Development

Multiple scientific research teams have participated in the research and development of the core projects for the national major strategies and the economic and social development of the Guangdong-Hong Kong-Macao GBA, such as the Beidou Navigation system, the "Sun Yat-sen University" ocean comprehensive scientific research internship ship and the "Sun Yat-sen University Polar' ice breaking scientific research ship, Southern Marine Science and Engineering Guangdong Provincial Laboratory, Guangdong Province Key Laboratory of Advanced Intelligent Perception Technology, Guangdong Province Key Laboratory of Sea, Sky and Space Communication, Guangdong Provincial Department of Education Intelligent Holographic Radar Engineering Technology Research Centre, Guangdong Province Intelligent Perception and Trusted Navigation Engineering Laboratory, Shenzhen Key Laboratory of Intelligent

Microsatellite Constellation Technology and Application, Shenzhen Key Laboratory of Navigation and Communication Integration. They have collaborated with the partner units to carry out the technical research and development, guided the graduate students to carry out the professional practice based on the engineering projects, served the major national needs and economic and social development of the GBA, and achieved the original intention and mission of "casting heavy weapons for the country". Assisted the cooperative units of the practice base in solving the practical and technical problems, and signed many horizontal scientific research contracts, improving the market competitiveness of industry enterprises. We have sent graduate students to graduate training bases to combine classroom learning with the production practice, contributing our youth to the comprehensive development of the Guangdong-Hong Kong- Macao GBA.

3.5. Significant Improvement in Social Identity

The practical effect of the professional degree graduate training model integrating the industry and education has been fully recognized by the superior supervisory department and peers. In 2023, the college won the first batch of Huawei new engineering projects of the Ministry of Education's collaborative education project of the industry-university cooperation, whose name is "New Generation Internet Technology and Practice". In the 11th evaluation of the educational and teaching achievements at Sun Yat-sen University, the project "Exploration and Practice of Deep Integration of Industry-education and Collaborative Education Model with the Intelligent Base" has won the first prize, and the project "Construction and Practice of Deep Integration of Mathematics and Computer Education System for Training 'New Engineering' Talents" has won the second prize.

4. CONCLUSION

The "new engineering" has put forward the new requirements for the innovative talent training mode of the universities, and collaborative innovation between industry, academia, and research provides new ideas for cultivating the composite and applied high-level talents that meet the development needs of the new era. To address some of the existing problems in the current graduate training model, this paper proposes build the professional degree graduate training model that integrates the industry and education, guided by the national major strategies, economic and social development in the Guangdong-Hong Kong-Macao GBA and enterprise needs. This model aims to improve the practical and innovative abilities of the graduate students, and build a "Trinity" training community, adopt a "Three-layer progressive" integrated training method and take the "Five commonalities" as an important measure, which can adapted to the requirements of the composite applied high-level talents in the context of the collaborative innovation between the "new engineering" and industry-academia research. I hope to provide the assurance for the successful implementation of this training model through the promotion and implementation of the above strategies, jointly build the professional degree graduate education community, and then contribute to the reform of the professional degree graduate education in Chinese universities.

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CONFLICT OF INTEREST

All authors confirmed that there is no conflict of interest involve with any parties in this work.

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