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Strategic Construction and Practical Innovation for the Collaborative Development of Graduate Education in the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN

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Abstract: The coordinated development of postgraduate education between the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN is an important practice serving the national strategy and promoting the modernization of Chinese education. Both sides have formed a "competitive and complementary" pattern in key areas such as artificial intelligence, tropical agriculture, and traditional Chinese medicine through joint laboratory construction and innovative joint training mechanisms, such as the Digital Silk Road Laboratory of South China University of Technology and Universiti Teknologi Malaysia, and the "Dual Campus + Dual Mentor" model of Sun Yat-sen University and the National University of Singapore. Institutional innovation has broken through barriers such as credit recognition and joint degrees, and a "three-in-one" guarantee system has been established. In terms of cultural exchange, mutual learning is promoted through heritage revitalization and curriculum integration to enhance people-to-people ties. Guangdong Province supports the deepening of cooperation through special funds and risk prevention and control, providing a "Chinese solution" for the internationalization of education in developing countries and contributing to the building of a community with a shared future for mankind.

Keywords: Guangdong-Hong Kong-Macao Greater Bay Area; ASEAN; Postgraduate Education; Coordinated Development; Chinese-style Modernization.

1. Introduction

The report of the 20th National Congress of the Communist Party of China emphasized that "we should expand international scientific and technological exchanges and cooperation, strengthen the construction of an internationalized scientific research environment, and form an open and innovative ecosystem with global competitiveness." This important assertion has pointed out the direction for the opening up of postgraduate education in the new era[1].As an important support area for the Belt and Road Initiative, the Guangdong-Hong Kong-Macao Greater Bay Area's in-depth interaction with ASEAN countries in the field of education is not only an educational practice for building a community with a shared future for mankind, but also an important exploration for promoting the modernization of education with Chinese characteristics[2].

At present, the National University of Singapore has consistently ranked among the top 15 in the QS World University Rankings for five consecutive years. The University of Malaya in Malaysia has entered the global top 100 in the field of engineering, and Chulalongkorn University in Thailand has set a regional benchmark in medical education.These educational achievements form a strategic response with major research platforms such as Sun Yat-sen University's "Tianqin Project" space gravitational wave detection and South China University of Technology's "Supercomputing Center of the Guangdong-Hong Kong-Macao Greater Bay Area"[3].Universities in the Guangdong-Hong Kong-Macao Greater Bay Area and top universities in ASEAN not only engage in healthy competition in terms of talent introduction and scientific research output, but also establish in-depth cooperation mechanisms in areas such as joint training and technology transformation[4].

This kind of educational coordinated development that transcends geographical boundaries is breaking the traditional pattern of higher education centers being marginal. Through the joint construction of the "South China Sea Education Innovation Corridor", a new educational ecosystem featuring joint talent cultivation, resource sharing and co-creation of achievements is being formed[5].In particular, the Hong Kong University of Science and Technology (Guangzhou) and Nanyang Technological University in Singapore have jointly established the "Digital Twin Joint Laboratory", combining the industrial advantages of the Guangdong-Hong Kong-Macao Greater Bay Area with Singapore's R&D advantages. This initiative aims to cultivate compound talents in the field of intelligent manufacturing who are proficient in core algorithms and familiar with industrial applications, providing intellectual support for the upgrading of regional industrial chains [6].

2. The Inevitability and Complementarity of Strategic Synergy

2.1. Three Major Trends in the Reconstruction of the Global Education Landscape

The coordinated development of postgraduate education in the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN has profound contemporary inevitability. The world is currently undergoing major changes unseen in a century. The global higher education landscape is accelerating its reconstruction, presenting three major characteristics: the

knowledge production model is transforming towards interdisciplinary collaborative innovation, the allocation of educational resources is concentrating on digital platforms, and the standards for talent cultivation are enhancing global competence. Nanyang Technological University in Singapore has deeply integrated artificial intelligence technology into teaching and research through the construction of the "Smart Campus 3.0" project. Its "Flipped Classroom + Project Practice" training model has been rated as the best in Asia by Times Higher Education for three consecutive years. Relying on its research advantages in the entire palm oil industry chain, the University of Putra Malaysia has established a practical teaching system from "laboratory to plantation", and the postgraduate students it cultivates lead the formulation of international standards for palm oil production in ASEAN. Thailand Agricultural University has established a database of tropical agricultural ecosystems. Its postgraduate training implements a dual-track system of "field laboratory + digital simulation", making significant contributions to food security in ASEAN countries.

2.2. The Complementary Practices among Guangdong, Hong Kong, Macao and ASEAN

Facing the innovative development trend of universities in ASEAN, universities in Guangdong have proactively built a cooperative pattern of "complementary advantages and differentiated development". South China Agricultural University and the University of Agriculture of Thailand have jointly established the "China-Thailand Tropical Agriculture Joint Research Institute", innovating a collaborative training mechanism of "scientific research breakthroughs + technology promotion". At the scientific research level, both sides have focused on the gene editing technology for rubber tree disease resistance and formed a cross-border joint research team. At the training level, a "1+2" segmented training system is implemented (one year of studying molecular biology in Guangzhou and two years of conducting field experiments in Bangkok). At the promotion level, a "graduate student + farmer" technical assistance model has been established to ensure that the rubber yield-increasing technology covers the plantations in the five northern provinces of Thailand.

3. The Practical Path of Mechanism Innovation

3.1. A Breakthrough in the Joint Training Model

The coordinated development of postgraduate education among Guangdong, Hong Kong, Macao and ASEAN in the new era must adhere to the correct value orientation. The "China-Singapore International Joint Research Institute" jointly established by Sun Yat-sen University and the National University of Singapore has explored a "dual-campus + dual-mentor" training mechanism in the field of optoelectronic materials: academic guidance is jointly provided by professors from the Institute of Superhard Materials of Sun Yat-sen University and the Nanoscience Centre of the National University of Singapore, while industrial mentors come from Huawei Singapore Research Institute and Guangzhou Visyuan Electronics. The training program sets a dynamic ratio of the "Basic Theory Module" and the "Engineering Application Module". Postgraduate students can independently choose the basic theory enhancement courses at the Singapore campus or the engineering practice courses at the Shenzhen Campus according to their research directions. The degree thesis implements a "double blind review + industrial evaluation" system, which not only ensures academic rigor but also emphasizes technical practicality. This kind of cooperation is neither a simple transplantation of models nor a passive alignment of standards, but an educational innovation based on China's reality.

3.2. Institutional Innovation

In the field of digital economy, the "Digital Silk Road Laboratory" jointly established by South China University of Technology and the University of Technology Malaysia focuses on the strategic demand of 5G communication standard formulation and innovates a full-chain training model of "technology research and development - standard formulation-industrial application". The laboratory, in collaboration with Huawei Malaysia Branch and the Malaysia Digital Economy Development Authority, has transformed China's practical cases in the field of new infrastructure into teaching resources. It has developed distinctive courses such as "Cross-border Data Governance" and "Smart Grid Optimization", and the postgraduate students it has trained have led the completion of the intelligent transformation plan for the East Coast Rail Link in Malaysia. These practices strongly prove that only by adhering to the dialectical unity of independent innovation and open cooperation can one gain the initiative in international education competition.

The construction of the Guangdong-Hong Kong-Macao - ASEAN postgraduate education community requires innovative institutional design. Chinese-style modernization is essentially an innovative practice of institutional modernization, which requires us to construct an educational cooperation model with Chinese characteristics. The "Maritime Silk Road University Alliance" led by Jinan University, in collaboration with 21 other universities including Nanyang Technological University in Singapore and the University of the Philippines, has achieved three major breakthroughs at the institutional level: establishing a "credit bank" to facilitate cross-university credit accumulation and transfer, developing a "joint degree" certification system, and creating "mobile research positions" to promote faculty sharing. During the promotion process, the "classified connection" strategy was creatively implemented: Cooperation with Singaporean universities focused on cutting-edge fields such as integrated circuits and artificial intelligence, jointly building a "Semiconductor Materials Joint Training Base", and implementing the "dual mentor + enterprise project" model; In collaboration with Thai universities, focusing on modern service industries, a "Tourism Management Innovation Center" was established in Bangkok, and a curriculum system of "Digitalization of Cultural Heritage + Smart Tourism" was developed. Strengthen Marine economic cooperation with Indonesian universities. Relying on the construction of the "21st Century Maritime Silk Road", establish a "Marine Ranch Research Station" to cultivate postgraduate students to master deep-sea aquaculture and ecological restoration technologies.

3.3. Risk Prevention and Control System

For this purpose, the Department of Education of

Guangdong Province has issued the "Guidelines for Postgraduate Education Cooperation among Guangdong, Hong Kong, Macao and ASEAN", and established a "three-in-one" guarantee system: in terms of ideological security, a pre-review system for cooperation projects has been established, and an assessment committee composed of experts in Marxist theory and scholars in international relations has been formed; In terms of quality monitoring, the "unannounced inspection" system is implemented to conduct irregular on-site inspections of the joint training programs. In terms of risk management, a triple early warning mechanism of politics, law and culture should be established. These institutional innovations have enabled educational cooperation to maintain both openness and vitality while adhering to the bottom line of security, providing a referential "Chinese solution" for developing countries to promote the internationalization of education.

4. Collaborative Breakthroughs in Key Areas

4.1. Advanced Manufacturing Field

To deepen the cooperation in postgraduate education among Guangdong, Hong Kong, Macao and ASEAN, it is necessary to focus on breakthroughs in key areas. The current deep adjustment of the global industrial and supply chains requires that higher education cooperation must serve the urgent needs of the national strategy. The "Advanced Manufacturing Joint College" jointly established by Southern University of Science and Technology and Ho Chi Minh City University of Science and Technology in Vietnam targets the pain points of manufacturing upgrading in ASEAN and builds a "demand-oriented - capability profiling - curriculum reconstruction" training system: Through research on 200 manufacturing enterprises in Vietnam, it identifies urgently needed areas such as intelligent equipment operation and maintenance and industrial Internet security; Draw the ability map of "mathematical modeling + engineering practice + cross-cultural communication"; Develop a modular course cluster, among which the course "Industrial Robot Fault Diagnosis" directly adopts real cases from Zhuhai Gree's intelligent factory. The first batch of postgraduate students trained by this college led the completion of the transformation of Vietnam's first automated automotive production line, increasing production efficiency by 40% and reducing the failure rate by 65%.

4.2. Modernization of Traditional Medicine

The "Traditional Chinese Medicine ASEAN Center" jointly established by Guangzhou University of Chinese Medicine and Khon Kaen University of Thailand has broken through the barriers of traditional medical education: it has established a "standardized apprenticeship education" system, transforming the four diagnostic methods of observation, auscultation and olfaction, inquiry, and palpation into quantifiable teaching indicators. Develop the comparative study course of "Traditional Chinese Medicine - Thai Medicine" to promote mutual learning in traditional medicine; A demonstration base for the cultivation of traditional Chinese medicinal materials was established in Chiang Mai. Postgraduate students mastered the key technologies of the industrial chain through the full-process practice of "cultivation - processing - clinical practice". This "theoretical inheritance + practical innovation" training model has promoted the coverage rate of traditional Chinese medicine in medical institutions in ASEAN countries to increase to 32%.

4.3. Competitive and Cooperative Relationships Drive Innovation

The coordinated development of postgraduate education in the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN requires the establishment of a new type of competitive and cooperative relationship. Dialectical materialism tells us that competition and cooperation are the dual driving forces for the development of things. The Hong Kong University of Science and Technology (Guangzhou) and the National University of Singapore are engaged in a "competitive and cooperative game" in the field of artificial intelligence: in terms of talent introduction, the two sides are competing for top young scholars through the "Pearl River Talent Program" and the "Singapore Science and Technology Scholarship". In terms of scientific research and technological breakthroughs, they have jointly carried out research on "cross-domain federated learning" to jointly solve the problems of data privacy and sharing. In terms of technology transfer, they not only compete in the number of intelligent algorithm patents but also share application scenarios through the "Guangdong-Hong Kong-Macao - Singapore Technology Transfer Center". This competitive and cooperative relationship has given rise to a unique innovation ecosystem: in the past three years, the two sides have jointly applied for 58 international patents and established 12 technology enterprises. Among them, the "Smart City Traffic Optimization System" has been simultaneously applied in Singapore's CBD and Tianhe District, Guangzhou. Shenzhen University and the University of Technology Malaysia have formed a "spiral upward" cooperation in the field of materials science: by regularly holding the "Materials Innovation Competition" to stimulate competitive awareness, establishing a "Joint Patent Pool" to share scientific research achievements, and forming a "cross-border technology transfer team" to solve the lifespan problem of OLED materials. For this purpose, Guangdong Province has established a "Competitive Intelligence Sharing Platform", integrating data such as the development strategies, discipline layouts, and talent policies of ASEAN universities, generating a dynamic competitive map, and guiding universities within the province to build comparative advantages in cutting-edge fields such as artificial intelligence and quantum information.

5. Construction of an Educational Community Led by Cultural Mutual Learning

To promote collaborative innovation in postgraduate education among Guangdong, Hong Kong, Macao and ASEAN, it is necessary to strengthen cultural guidance. The "Joint Master of Education Program" jointly launched by South China Normal University and Indonesian teacher training institutions deeply integrates cultural dissemination into professional education: developing the course "Guangfu Business Group Culture and Modern Enterprise Management", and analyzing Lingnan business ethics through the Chen Clan Academy architecture; Organize Indonesian postgraduate students to participate in the "Re-tracing the Maritime Silk Road" study tour and experience the ancient commercial civilization at the No. 1 Nanhai Museum in Yangjiang. Establish a "Chinese Language + vocational

Education" practice base to assist Indonesian vocational colleges in developing training courses that integrate Chinese technologies. This kind of cultural immersion training enables graduates to become conscious disseminators of Chinese culture and promotes the offering of elective courses on Chinese business culture in 35 secondary schools in Indonesia. The "Guangdong-Hong Kong-Macao - ASEAN Cultural and Tourism Talent Training Base" jointly established by Zhuhai universities and tourism colleges in Macao and Thailand has innovated the practical teaching of "Cultural heritage revitalization" : The postgraduate team has used VR technology to restore the original appearance of the Ruins of St. Paul's in Macao and developed a "digital tour guide + live performance" integrated product. Protective development practices have been carried out at the Ayutthaya Ruins in Thailand, applying Chaozhou woodcarving techniques to the restoration of ancient buildings. These practices have made cultural heritage a bond connecting people's hearts, and the related achievements have been selected as cases of "Best Conservation Practices" by UNESCO.

6. Institutionalized Design of the Guarantee System

It is an urgent task to improve the guarantee system for the coordinated development of postgraduate education in the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN. Guangdong Province has established a "four beams and eight pillars" support system: At the policy level, a "ASEAN Education Cooperation Special Fund" with a scale of 5 billion yuan has been set up to provide 1:1 matching support for the construction of joint laboratories. At the platform level, the "China-Asean Education Innovation Island" is being built in Nansha, Guangzhou, gathering 32 joint laboratories and industrial transformation centers. Establish a five-dimensional evaluation system covering "political literacy, academic level, practical ability, cultural dissemination and international influence" at the quality level; At the risk prevention level, a three-level early warning mechanism of "red, yellow and blue" has been established. In the past three years, three cooperation projects with ideological risks have been halted. Especially under the background of the accelerated educational infiltration of the "Indo-Pacific Strategy" in the United States, universities in Guangdong have innovated the dual defense line of "ideological and political education in courses + cultural infiltration" : setting up the compulsory module of "Contemporary China" in the cross-border training program and building an online ideological and political resource library containing 200 cases; Establish the "Guangdong-Hong Kong-Macao - ASEAN Young Scholars Forum" and set up a regular dialogue mechanism to resolve cultural misunderstandings. These measures have formed a "safety valve" for the opening up of education to the outside world, and the relevant experience has been included in the "Guidelines for Risk Prevention and Control of Education Opening Up in the New Era" by the Ministry of Education.

7. Conclusion and Prospects

Based on the development coordinates of the new era, the collaborative innovation between the Guangdong-Hong Kong-Macao Greater Bay Area and ASEAN countries in the field of postgraduate education is writing the answer sheet of The Times for the modernization of China's education through practical exploration. A research team from Malaysia founded a technology enterprise in the Songshan Lake International Innovation and Entrepreneurship Base in Dongguan. The intelligent logistics sorting system independently developed by them has been successfully applied to the construction of the smart terminal in Port Klang. A multinational research team led by high-level talents from Thailand, relying on the scientific research platform of South China University of Technology, has made breakthrough progress in the field of natural rubber nanocomposites. The brain-computer interface rehabilitation training platform jointly developed by Shenzhen University and a Singaporean research institution has been applied on a large scale in the clinical treatment of neural repair in medical institutions in Southeast Asia. Looking to the future, the education collaboration among Guangdong, Hong Kong and Macao and ASEAN will deepen high-level opening up and cooperation, promote the advancement of education collaboration to a higher-quality development stage, and provide Chinese wisdom for the innovation of the global science and education cooperation model.

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