

Research on the Construction of Makerspaces in the Colleges and Universities of Guangdong Province from the Perspective of Industry-Education Collaboration

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ABSTRACT

By taking the relevant basic theories of the makerspaces as the research foundation and the countermeasures for the construction of the makerspaces in the colleges and universities of Guangdong Province as the research object, this paper analyzes the main difficulties that restrict the development of makerspaces in the colleges and universities of Guangdong Province based on a practical investigation. Combined with the educational concept of production-education collaboration, this paper puts forward the innovative and operable countermeasures from such aspects as the mechanism of organization and management, the mechanism of tutors' guidance, the mechanism of financing and investment of capitals, the supporting mechanism of facilities and the resource-sharing mechanism, so as to promote the in-depth development of the makerspaces in the colleges and universities of Guangdong Province.

Keywords: industry-education collaboration, makerspaces in colleges and universities, construction research

1. INTRODUCTION

In March 2015, the General Office of the State Council issued The Guidance of the General Office of the State Council on the Development of Makerspaces to Promote the Public Innovation and Entrepreneurship, which proposed to speed up the construction of makerspaces, make full use of the favorable conditions of science and technology parks in universities, university campuses, research institutes and other institutions, play the role of the main force, and build a batch of low-cost, convenient and open makerspaces with all factors. Under the support and encouragement of a series of national policies aimed at "innovation and entrepreneurship", there emerged an explosive and flourishing trend in the development of China's makerspaces. Major colleges and universities, in particular, have been trying to create their makerspaces with competitive strength and development potential in combination with their school characteristics, which can not only provide one-stop services to the college students for their activities of innovation and

entrepreneurship, but also promote the cultivation of innovative and entrepreneurial talents and regional economic growth. Therefore, in order to further promote the development of makerspaces in the colleges and universities of Guangdong province and deepen the educational reform of innovation and entrepreneurship, it is necessary to conduct an in-depth analysis of the connotation of the makerspaces, study the development trend of the makerspace in colleges and universities and further put forward the construction countermeasures [1].

2. CONNOTATION OF MAKERSPACES

Under the background of social networking, informatization and intellectualization, the makerspace is an open service platform of innovation and entrepreneurship with epochal and innovative characteristics which is built on the basis of learning the advantages of foreign makerspaces, at the same time of inheriting the development experience of the traditional incubators of entrepreneurship in China in March 2015,

the General Office of the State Council listed the definition of the makerspaces in the Guidance of the General Office of the State Council on the Development of Makerspaces to Promote the Public Innovation and Entrepreneurship: the makerspace is a general term referring to the new type of low-cost, convenient and open service platforms for innovation and entrepreneurship with all factors, which are constructed through the marketized mechanism, the professional services and the capitalized method to conform to the characteristics and needs of innovation and entrepreneurship in the network era. In May 2020, Guangdong Province issued The Management Measures for the Incubation Carriers of Scientific and Technological Enterprises in Guangdong Province to reinforce the standardized management of the incubation carriers of scientific and technological enterprises, build an excellent ecological environment for scientific and technological entrepreneurship, bring the public entrepreneurship and mass innovation to a new level and help construct an international center for scientific and technological innovation in Guangdong-Hong Kong-Macao Greater Bay Area. The document further explained the definition of makerspaces: the makerspace shall take the entrepreneurs, the entrepreneurial teams and the start-ups as the service objects and realize its main functions of helping the entrepreneurs to turn their ideas into products, their products into projects and their projects into enterprises by providing the work space, the network space, the social space and the resource-sharing space, as well as the low-cost, convenient and open incubation services with all factors [2]. For the first time, the management of the makerspaces, the incubators, the accelerators and other incubator carriers is collectively included in this method by referring to them as “the incubator carriers of science and technology enterprises.” Furthermore, centered on the whole life cycle of the growth of scientific and technological enterprises with the incubators as the core, it extends to the front and back ends of the incubators, and guides the construction of an incubation chain with the integration of “the makerspaces, the incubators and the accelerators for the scientific and technological enterprises.

3. CONNOTATION OF MAKERSPACES IN UNIVERSITIES AND COLLEGES

The makerspaces in China's colleges and universities are the products of the close integration of industry, education, research and entrepreneurship in the era of “innovation and entrepreneurship”. By taking the colleges and universities as the main body, they are open, all-factor and multi-functional practice carriers which are cooperatively constructed by the government, the enterprises and other social subjects to serve the innovation and entrepreneurship of colleges and universities. As the State Council, the Ministry of

Education, the Ministry of Science and Technology and other ministries attach great importance and give great support to the makerspace construction in colleges and universities, the number of the makerspace in colleges and universities continues to increase, the scale of operation has expanded, the quality of development has improved, the operation mode has upgraded, and the role of the makerspaces in promoting the process of innovation and entrepreneurship in colleges and universities has also increasingly strengthened. At present, according to their function, the makerspaces in colleges and universities in China can be divided into four types: the training and counseling type, the creator-incubated type, the activity-aggregated type and the type of comprehensive entrepreneurial services. Among them, the training and counseling type holds the majority, which mainly refers to using makerspaces in colleges and universities as the place for innovation and entrepreneurship training and guidance.

4. THE DEVELOPMENT STATUS OF MAKERSPACES IN UNIVERSITIES AND COLLEGES OF GUANGDONG PROVINCE

China offers great financial support to the development of the makerspaces in Guangdong Province. From 2016 to 2018, the amount of financial support for the makerspaces in Guangdong Province has been constantly increasing, reaching 304 million yuan in 2018, the amount of which ranked the third in the whole country. In 2017, more significant effects of offering employment and gathering innovation were shown from the teams and enterprises of the makerspaces in Guangdong Province [3]. Among them, the cumulative number of the entrepreneurial teams and enterprises with college students as the founders was the largest, which was 5,769 with an increase rate of 48.3 %. In 2018, the proportion of the makerspaces in Guangdong Province was at a low level compared with that of other provinces in China, but it rose again to 12.33 % in 2019. In 2018, the number of service personnel in the makerspaces of Guangdong Province reached the maximum of 16,121, which was actually for the second time to reach the maximum among the whole nation within the two consecutive years. According to the national torch statistics of 2019, Guangdong Province had 1,036 incubators and 986 makerspaces, with an increase of 38 % year on year, ranking a stable first in the number of China's makerspaces. In 2020, the number of the incubators and the makerspaces in Guangdong Province reached more than 1,000 respectively, with an adding of 5,000 new incubators and an offering of entrepreneurship and employment for more than 600,000 people.

4.1 The Development Status of the Makerspace in Jinan University

On November 18, 2016, Jinan University established the WE innovation makerspace for the Chinese youths from Hong Kong, Macao and Taiwan. Under the witness of Yuanping QIU, the then Director of Overseas Chinese Affairs Office of the State Council, the school was officially established and became China's first makerspace specially established for the Chinese youths from Hong Kong, Macao and Taiwan, highlighting the support for the innovation and entrepreneurship of the youths from Hong Kong, Macao and Taiwan.

Since its establishment, "the WE innovation makerspace" has cooperated with Guangdong, Hong Kong and Macao Youth Entrepreneurship Incubator and other units in Guangzhou to gradually improve the ability to offer services to the entrepreneurial projects for the overseas students from Hong Kong, Macao and Taiwan. A perfect system of operation and management and mechanism of incubation is formed, which provides free office space, network access and other service facilities as well as more enhanced incubation conditions for the overseas students from Hong Kong, Macao and Taiwan. At present, the makerspace has been constructed throughout the four campuses of Jinan University in three regions, forming the "five-in-one" spatial layout of the school headquarters, Panyu, Shenzhen, Zhuhai and the Science and Technology Park (with Shenzhen and Zhuhai under construction). Jinan University takes the lead in building the platform of makerspaces for college students' innovation and entrepreneurship. Relying on the advantageous disciplines and key laboratories of the university, a number of workshops for the students' innovation and entrepreneurship have been established. From 2016 to 2020, more than 110 projects in total have been established, including more than 60 registered companies of incubation, and some of the projects' operating incomes have exceeded one million yuan until now.

4.2 The Development Status of the Makerspaces in Guangdong University of Finance & Economics

"School of Entrepreneurship of GDUFE" is operated by Guangdong University of Finance & Economics. In December 2017, this makerspace in Guangzhou City was declared, and it was officially approved on January 8, 2018. It was included in the Management Account of the makerspaces in Guangzhou City and was endowed with a registration certificate. With a commitment to providing guidance to policies, the communication of projects, the entrepreneurship-and-investment docking and other services for numerous entrepreneurs, it aims

to construct the most influential makerspace in South China.

Currently, the constructed functional areas include the business incubator park and the makerspace coffee and so on, and it plans to build a students' business park which shall be composed of the open innovation laboratory (the makerspace laboratory), the communication center of innovation and entrepreneurship, the business incubator park of culture and entrepreneurship, the e-commerce business incubator park and other functional areas in Guangzhou. By reinforcing the teaching concept of "promoting the training of innovation with entrepreneurial projects, motivating the education of entrepreneurship with entrepreneurial practices, and stimulating the entrepreneurial enthusiasm with entrepreneurial models", the entrepreneurial park is committed to exerting the effects of knowledge spillover and the creation of entrepreneurial opportunities in the process, to improve the communication of the entrepreneurial team's invisible entrepreneurial knowledge through the aggregation effect of the entrepreneurial park, to gradually form the database of the entrepreneurial teaching cases through the deep excavation of the students' entrepreneurial process, and to stimulate the students' entrepreneurial enthusiasm through the mechanism of regular supplement and elimination of the entrepreneurship projects [4].

4.3 The Development Status of the Makerspaces in Guangdong Communication Polytechnic

Under the support from Guangdong Communication Polytechnic, the makerspace of Guangdong Communication Polytechnic (the 125 makerspace factory) was established on September 2015. Based on the characteristics and advantageous resources of highways, waterways, tracks, transportation, intelligent transportation and other majors, it has prepared more than CNY 4 million incubation funds of innovation and entrepreneurship. Around the technological development, the marketized operation, the team construction and training, the enterprise incubation and other sections, it mainly provides the services of innovation and entrepreneurship for the numerous groups of teachers and students and the small and medium-sized scientific and technological enterprises outside the campus, and builds an integrated service system to provide the protection of intellectual property, the services of information and legal advisory, the training of innovation and entrepreneurship, the development and management of human resources, the services of starting businesses and operation and the resource exchange and docking to meet the needs of the public for innovation and entrepreneurship.

5. THE MAIN DILEMMAS OF THE DEVELOPMENT OF THE MAKERSPACES IN THE COLLEGES AND UNIVERSITIES OF GUANGDONG PROVINCE

5.1 The Construction of the Teaching Staff Needs to be Standardized

There are few full-time teachers to practice the education of innovation and entrepreneurship in colleges and universities of Guangdong Province, and it is quite difficult to meet the students' requirements with the current number of the entrepreneurial tutors of the makerspaces in those colleges and universities. In fact, some of those entrepreneurial tutors are from the administrative department of those universities, and some of them are the teachers of the Marxist College. Before taking the tutor's responsibilities, they have worked for a period of time. Now some are still doing the part-time job of managing the students as counselors or other administrative employees. Actually, after a temporary or short training, they still lack the awareness of the importance of guidance in the innovation and entrepreneurship project, lack experience in guiding innovation and entrepreneurship projects, and cannot provide efficient services to the project teams. Although some of the entrepreneurial tutors are full-time teachers of the category of economic management with sufficient professional knowledge and great ability to do scientific research, they do not have the actual experiences of innovation and entrepreneurship or the experience of managing enterprises. When guiding the project team to write business plans and design business models in the early stage of construction, they can give relevant guidance and help [5]. However, when it comes to the actual construction and operation of the entrepreneurial projects, it is difficult for them to give the project team any "symptomatic" innovation points or ideas.

5.2 The Mechanism of Financing and Investment Needs to be Improved

The makerspaces in colleges and universities are the initial place for college students to perform brainstorming and to generate the ideas of innovation and entrepreneurship, but there is still a huge gap between the ideas and reality. First of all, they are faced with the financial support which is a necessary element to transform the ideas into practice and results. The makerspaces in colleges and universities are also the "front-end" incubators of the college students as creators, and they should be equipped with the function of providing entrepreneurial and financing services for the recruited creators. However, in reality, due to the lack of profitable entrepreneurial projects or the lack of sensitivity to the market, there are still not many college

students who are actually funded. In other words, the vast majority of the college students as creators mainly rely on themselves to find the needed funds, while the formal lending units tend to hold reservations on college students' credit, and believe that they have not yet cultivated the ability to shoulder the financial risk of large loans [6]. For this reason, even if some lending institutions do give support, their support is insufficient, which cannot provide the necessary support for the landing of the college students' larger makerspaces. Hence the cultivation and incubation of the college students' makerspaces are objectively restricted.

5.3 The Hardware and Software Facilities Need to be Fully Equipped

The number of the registration and archival filing of the makerspaces in colleges and universities of Guangdong Province has experienced a sharp increase, and the entitative spaces have been established and begun to recruit the college students as creators. However, the current situation is that most of the makerspaces in colleges and universities can only provide office space, office seats and other simple support for the college students, while most of the experimental facilities, the apparatus and equipment and the technical services involved in the projects of innovation and entrepreneurship are not in place, which will affect the further performance of the projects of innovation and entrepreneurship with high technical contents [7]. Still worse, a large number of the makerspaces in the colleges and universities of Guangdong Province failed to complete the registration and archival filing in accordance with the required procedures by the science and technology department of the local government, so the university's makerspaces cannot directly provide "the registration address" when college students as creators need to register their companies. In addition, in terms of the entrepreneurial counseling, the counseling of policies, risk investment and other services, due to such problems as the professional degree, the stability and the maturity of the entrepreneurial tutor teams, the tutors failed to "feel the pulse" of the college students as creators, neither can they provide the professional and targeted services, which restricts the development of the makerspaces in colleges and universities as well as the college students as creators.

5.4 There is a Lack of Resource-Sharing Mechanism

The makerspaces in the colleges and universities of Guangdong Province can gather excellent college students of different majors, and the college students with different projects of innovation and entrepreneurship also have common interest in project selection, team construction, accounting, operation and

management and so on. However, after observing the current college students as creators in the makerspaces of colleges and universities in Guangdong Province, it was found that they would only focus all their energies on their own projects of innovation and entrepreneurship, rather than perform any effective communication or knowledge sharing with each other, and their relationship is limited within the realm of merely working together. There is a lack of the linkage mechanism within the makerspaces, and the managers of the makerspaces have not played a corresponding role in encouraging and guiding the recruited team of creators. In addition, the lack of innovative and entrepreneurial culture both on campus and in regions leads to the lack of vitality in makerspaces.

6. ADVICE ON THE FURTHER DEVELOPMENT OF THE MAKERSPACES IN THE COLLEGES AND UNIVERSITIES OF GUANGDONG PROVINCE

6.1 To Establish a Comprehensive Team of Management and Services

In the start-up period of the makerspaces in colleges and universities, the administrative staff generally lack the professional quality and the experience of management, and hence they should try to keep pace with the times and always pay attention to the latest policies of the torch center of the Ministry of Science and Technology of China and other departments on the makerspaces. In addition, they should try to learn actively as well as organize and participate in the training related to the makerspaces and the technological innovation and entrepreneurship, such as the training of the mid-level administrators of the incubators of the technological enterprises. At the same time, it is necessary for them to understand the latest developments of the makerspaces in society, strengthen the exchanges with the administrative staff of the makerspaces in society, share experiences and promote the development of every member in the makerspace. To improve the operation and management of the makerspaces, colleges and universities can hire some seasonal labors and entrepreneurs with professional qualifications and management experience to work part-time as makerspace managers. They can also select the excellent students who are interested in the makerspaces to establish the college students' community and organization, namely, the college students' voluntary association for innovation and entrepreneurship, and then carry out the targeted and professional training for them in accordance with the requirements and definition of "the employees of the incubators in technological enterprises", so that they can participate in the construction of the makerspaces in colleges and

universities, cultivate their ability and experience of management, at the same time of creating a classic case and characteristic model of how entrepreneurship drives employment.

6.2 To Establish the Diversified Mechanism of Financing and Investment

The function of the financial investment of the makerspaces in colleges and universities in Guangdong Province should be improved, and the scientific and technological financial ecological network of the incubation carriers of the scientific and technological enterprises should be actively constructed, so as to lower the threshold of innovation and entrepreneurship. The incubators and makerspaces should be used as the sci-tech financial workstations, and the institutions of banks and equity investment should be used as the sci-tech financial commissioners. Through the linkage between the sci-tech financial workstations and the sci-tech financial commissioners, the precise sci-tech financial services of "the creditor's rights + the stock rights" can be provided for the enterprises. Gradually, the "1 + 1" mode covering the whole city's FinTech incubation system of empowerment can be established, and the tax preferential policies suitable for the makerspaces of colleges and universities shall be explored.

6.3 To Establish the System of Complete Services in Support of Facilities

While maintaining sustainable and rapid development, the makerspaces in colleges and universities should provide a complete set of basic office environment for the college students as creators, including the stations, the sites, the desks and chairs and the network. Above all, it is necessary for them to provide comprehensive entrepreneurial services, construct the system of the services of the whole process, and continuously enhance the level of hardware services. Relying on the advantages of characteristic majors and school running in colleges and universities, they can cooperate with other research and development institutions or high-tech enterprises to jointly build the research and development institutions, such as the sci-tech research and development centers, the scientific research laboratories and other innovative and entrepreneurial platforms, to provide college students' innovative and entrepreneurial teams with cutting edge technology, and cash-oriented instruments and facilities [8].

6.4 To Establish the Resource-Sharing Environment of Production-Education Collaboration

The communication and cooperation between the makerspaces in colleges and universities and other incubator carriers of science and technology should be reinforced so as to realize the mutual support and achieve the mutual complementarity in the interest of their common development, while forming the resultant force of the development of the makerspaces in colleges and universities through the co-construction of disciplines, the technical cooperation and the resource sharing and so on. The Guangzhou Science Business Incubators Association should strengthen the connection, communication and cooperation of the incubator carriers of the scientific and technological enterprises in various regions of this province, such as the makerspaces, as well as the enterprises in incubation, with the scientific research institutions, the intermediary service institutions and the venture capital institutions and so on. Through the coordination of various actions, regular training, and network information services, the sharing mode of “off-campus resources + on-campus resources” is realized. Commitment is made to enhance the incubation ability of the incubator carriers of the scientific and technological enterprises, such as the makerspaces in various regions of Guangdong Province. In this regard, it is essential to motivate the transformation of scientific research achievements and accelerate the cultivation of entrepreneurs, thereby promoting the establishment of a highly efficient and first-class incubation system of scientific and technological innovation in Guangdong Province.

7. CONCLUSION

Makerspaces in colleges and universities are not only physical spaces, but also serve as important platforms for the country to implement innovation-driven strategic development. The research on the construction of the makerspaces in colleges and universities in China should deeply grasp the development law and internal mechanism of the makerspaces, focus on the research of innovation, and constantly explore and try to achieve new achievements in the development of the makerspaces in colleges and universities, so as to provide a reference for the rapid and comprehensive development of the makerspaces in other colleges and universities.

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