

Research on the Factors Influencing Maker Space Construction in Higher Vocational Colleges

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Keywords: Higher vocational colleges, Maker space, Innovation and entrepreneurship, Innovation capability, College students

Abstract: The construction of maker space provides an important means for the high-quality development of innovation and entrepreneurship education in higher vocational colleges. Based on the research method and technical route of grounded theory, this paper thoroughly analyzes the factors influencing the construction of maker space in higher vocational colleges in Fujian Province. The study found that, with the support of external conditions for maker atmosphere such as social environment, market environment and policy environment, maker space based on the combined force of maker content and maker capacity enables students, teachers, enterprises and other maker subjects to achieve performance in maker, thus achieving the goal of innovation and entrepreneurship education. Then specific strategies are proposed for the construction of maker space in higher vocational colleges from the perspective of creating a maker atmosphere, enhancing maker capacity, and stimulating maker vitality. The research not only enriches the connotation of maker space theory, but also provides practical reference for the improvement and optimization of innovation and entrepreneurship education in higher vocational colleges.

1. Introduction

In February 2016, the General Office of the State Council of China promulgated the "Guiding Opinions on Accelerating the Transformation and Upgrading of the Real Economy via the Development of Maker Space". The opinion takes it as an important task to encourage colleges and universities to build maker spaces based on their advantageous professional fields, and puts forward specific support policies. In March 2021, China's "14th Five-Year Plan and Outline of Vision 2035" further clarifies the need for "optimizing the innovation and entrepreneurship creation ecology" and "promoting the in-depth development of innovation, entrepreneurship and creation". Under the policy guidance and strong support of the state, many higher vocational colleges have established maker space for practical exploration, which plays a positive role in cultivating college students' innovation and entrepreneurship capabilities and advancing regional economic transformation and upgrading. With the in-depth advancement of maker development model, many problems are also exposed, such as insufficient co-governance, serious homogenization, single construction model, and imperfect evaluation system^[1]. This study conducts a comprehensive and systematic theoretical study on the factors influencing the construction of maker space in higher vocational colleges in

Fujian Province. It not only provides a specific theoretical interpretation of the connotation and development of the "Jinjiang Experience" in the new era, but also offers practical guidance for Fujian higher vocational colleges to improve students' innovation and entrepreneurship literacy, optimize the integration of production and education.

2. Theoretical Basis

Maker space in colleges and universities originates from the gathering place Hackerspace of European hackers in the 1990s. As a general term for a new type of innovation and entrepreneurship service platform for college students ^[2], it takes "maker fields" such as work space, cyber space, social space and resource sharing as the core carriers, organizes "crowd construction", project "crowdsourcing", fund "crowdfunding", resource "crowd sharing", product "crowd creation" and other business functions to incubate innovative ideas or products, as well as innovative teams, which involves a benign process of continuous improvement and formation through effective linkage with the market ^[3]. After nearly 3 decades of development, European and American countries have gradually built a maker ecosystem in colleges and universities. By defining the maker movement as an innovative model of contemporary university education, emphasizing the hands-on characteristics of maker, highlighting the technical attributes of maker spaces, various forms of activities are proposed, including joint work, prototype design and manufacturing, etc. ^[4]. China has carried out research on maker space since 2013, with the research contents, perspectives and paradigms constantly changing. The mode of college-led maker space is developing well ^[5]. Liu Xujun et al. (2018) ^[6] concluded that the construction of maker space in colleges and universities includes four modes: open laboratory mode, community integration mode, library creation mode, and school-enterprise cooperation mode. From the perspective of systems thinking, Chen Zhuowu (2022) ^[7] bases the research on maker space to explore the path of developing innovative and entrepreneurial talents.

Although the research and practice of maker space has a late start in China, it enjoys rapid development, not only quickly integrating with international standards, but also increasingly displaying Chinese characteristics ^[8]. With the joint support of the government, society and technology, the research on maker space content from the perspective of colleges and universities will pay more attention to the development of educational functions and the construction of platform ecology. It will focus on the shaping and improvement of the innovative spirit, entrepreneurial awareness and creative ability among college students, highlight the advantages of local colleges and universities in serving local economic and social development, and strive to propose countermeasures and paths truly conducive to the connotative development of college maker space. This research attempts to build a theoretical framework for identifying the factors influencing maker space construction in higher vocational colleges, and then clarify the inner deep relationship, so as to find a maker education model that fits the development of local higher vocational colleges.

3. Research Design

As an exploratory analysis, this research aims to analyze the influencing factors and path implementation of maker space construction in higher vocational colleges by using grounded theory research methods and technical routes. At the same time, in order to enhance the reliability and validity of the research data, the research data not only bases itself on in-depth interviews with the person in charge of maker space/entrepreneurship and innovation education in colleges and universities, but also provides supplementary verification through documents such as quality report of innovation and entrepreneurship education in colleges as well as participatory observation of

construction practice of maker space by project members. In addition, on the basis of data coding by using NVivo software, this research also arranges project members to manually code similar data for final comparison and improvement. It should be pointed out that, the project unit is located in Jinjiang, one of the top 100 counties in the country with a developed private economy and a strong maker atmosphere. Long adhering to the integration of production and education, innovation and entrepreneurship education in school-running orientation, the college strives to cultivate innovative and entrepreneurial talents with “hard work, innovation, courage to win”. The maker cases and materials are representative to some extent.

4. Research Process

According to the principle of grounded theory, the collected data were analyzed in three steps: open coding, axial coding and Selective coding [9]. First, 131 original sentences are retrieved by open coding, and finally 12 categories with certain logical relationships are formed through analogy analysis. Secondly, by axis coding, we re-integrate the decomposed data according to the logical relationship of "condition-action" or "action-result", and then incorporate it into five primary categories. The details are shown in Table 1.

Finally, on the basis of the above two stages, we further explore the connection between the elements, further abstract and conceptualize the connection, and finally establish the model of factors influencing maker space construction in higher vocational colleges, as shown in Figure 1.

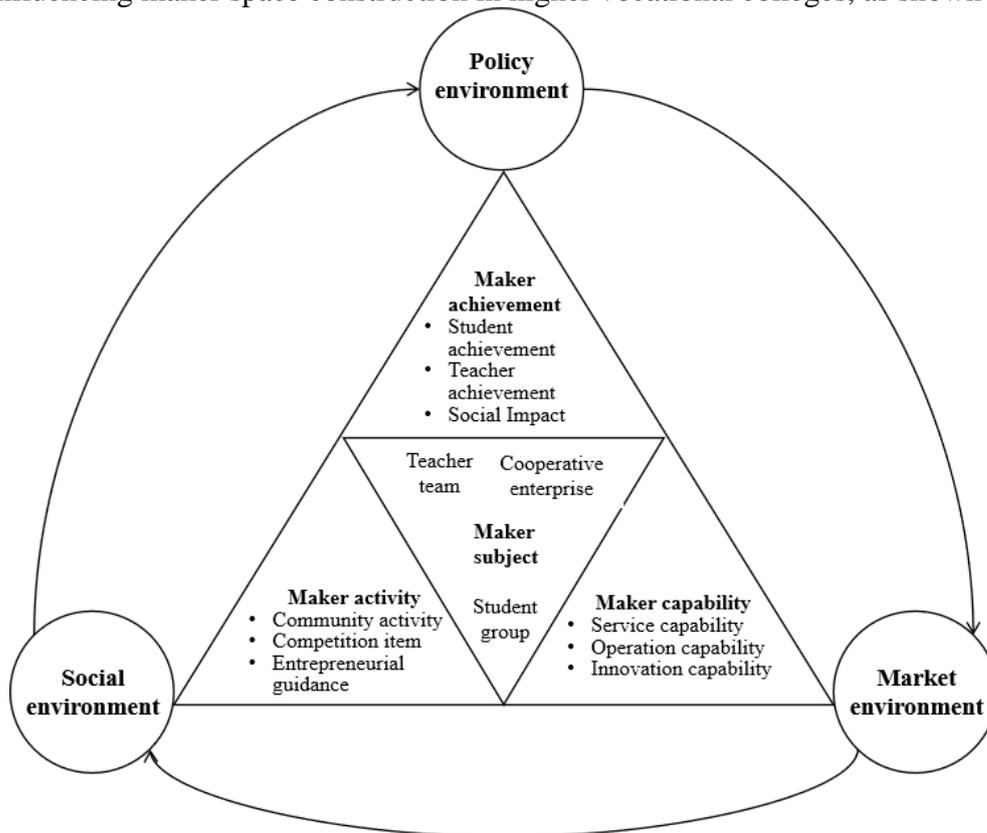


Figure 1: Model of factors influencing maker space construction in higher vocational colleges.

Table 1: Axial coding results.

Main category	Corresponding category	Original sentence excerpt
Maker subject	Student group	In addition to current students, graduates within three years of graduation can also enjoy relevant entrepreneurship policies. At the same time, it also serves students who have been employed after higher vocational enrolment expansion and dual system.
	Teacher team	Teachers not only give innovation and entrepreneurship guidance among students, but also integrate their own majors or projects in co-creation with students. For instance, the e-commerce team to help agriculture, the intelligent manufacturing technology innovation team, etc. are led by teachers.
	Cooperative enterprises	School-enterprise cooperation units, especially our alumni enterprises, not only act as mentors for entrepreneurship and innovation, but also cooperatively incubate some of their own projects with students and teachers, which currently seems to be a win-win strategy.
Maker activity	Community activity	We advocate the integration of professional education and innovation & entrepreneurship education. In addition to infiltration via teaching, we also let student associations explore the innovation & entrepreneurship elements and linkage with space. For example, the college's art workshop provides "creation" elements to several majors such as clothing, digital media, cultural tourism, etc.
	Competition item	The college attaches great importance to participating in competitions, and advocates the idea of promoting education and innovation via competitions such as skill competitions, Internet competitions, etc. The students display warm enthusiasm and have won many awards, which also enhances the maker effect to a certain extent.
	Entrepreneurial guidance	At the node of the enterprise training month, we will invite investment and financing institutions, start-up enterprises, and professional agencies to enter the space and provide students with accurate entrepreneurial guidance.
Maker capability	Service capability	Internally, we are a service platform for innovation and entrepreneurship, which is partly undertaken by third-party service enterprises; externally, we rely on the integration of production and education and technology commissioners to develop service capabilities.
	Operational capability	In terms of training, service and funding support, we have specific detailed policies and have assigned relevant management, finance, and technology teachers. In addition, financial enterprises and patent firms are also involved.
	Innovation capability	Our scientific research platforms (R&D centers) are all established in the maker space to strengthen technology transfer.
Maker achievement	Student achievement	The winning projects of College Students' Innovation and Entrepreneurship Competition are basically undertaken in the maker space. Now, some projects of alumni enterprises are also the prototypes of previous incubation.
	Teacher achievements	Vocational college teachers are evaluated not only by scientific research papers, but also by instruction in competition and benefit creation for colleges or enterprises. For instance, transverse income, patented technology... are important indicators for teacher promotion.
	Social impact	的Industrial partnership-type universities and entrepreneur cradles are our positioning in school operation, which is also a fact. Let alone the graduate employment rate, one can see it from the number and level of our school-enterprise cooperation. Many enterprises have projects in the space, some of which belong to landing enterprises.
Maker atmosphere	Social environment	Vocational colleges should take distinctive positioning, and implement micro-innovation on the existing basis... The needs of the society should be combined with the innovation and entrepreneurship of students. For instance, the present results of social services are the basic requirements of "two highs".
	Market environment	The logic of maker space team is to perform incubation according to the market demand, and the market demand must also derive from the industry side... Our specialties are favoured by the product development of local enterprises.
	Policy environment	At present, there are many relevant policies from the central to local governments, and local governments at all levels also carry out extensive publicity through new media, thus creating a very strong atmosphere of innovation and entrepreneurship.

Data source: compiled according to grounded theory coding.

5. Model Interpretation

Based on the above analysis, by combining the logical route of grounded theory, referring to the theory of maker space and the practice of maker space construction in the project unit, this study concludes that the construction of maker space in higher vocational colleges is affected by five major factors.

5.1. The Maker Subjects are the Core Elements, including the Three Main Bodies of Student Groups, Cooperative Enterprises and Teachers

The three interact and support the operation of the entire maker space, which forms the premise and foundation for achieving maker effectiveness.

5.2. Maker Activities form the Main Content, including Three Forms of Community Activities, Competitions and Entrepreneurial Guidance

The interaction of the three not only expands the maker connotation and scope, but also provides a source of power for achieving maker results.

5.3. Maker Capability is a Means of Guarantee, including Three Aspects: Service Capability, Operational Capability and Innovation Capability

The three work together to guarantee maker performance.

5.4. Maker Atmosphere is an External Condition, which Includes Three Parts: Social Environment, Market Environment and Policy Environment

The three work together in the internal construction of maker space and regulate the healthy operation of maker ecology in higher vocational colleges.

5.5. Maker Effectiveness is the Construction Goal, Including the Three Dimensions of Student Achievement, Teacher Achievement and Social Impact

The three are the result of the joint efforts of maker subjects based on the form of maker space activities and construction capabilities.

6. Conclusions and Policy Recommendations

This research establishes a steady state in which, under the external conditions provided by the social environment, market environment and policy environment, the maker space presents and incubates entrepreneurship and innovation projects through diversified service contents and perfect service mechanisms, and finally achieves actual effect in innovation and entrepreneurship education. This provides a reference for higher vocational colleges to evaluate the maker space development quality and explore construction paths. However, limited by the influence of the differentiation factors in maker resources, maker mechanisms, and maker atmospheres of different vocational colleges, the stable construction effect of make space in higher vocational colleges still requires multi-party explorations and efforts. In view of this, this study puts forward the following countermeasures and recommendations:

6.1. Highlight the Creation of Maker Atmosphere

The maker spaces of higher vocational colleges have typical regional, educational and non-profit characteristics [6]. Therefore, on the basis of integrating characteristic resources such as funds, talents, and majors, in terms of hardware environment, higher vocational colleges should do a good job in the construction of work space, network space, social space and resource sharing space; in terms of software environment, higher vocational colleges should, based on the needs of industrial and social development, rely on carriers such as student associations, academy communities, social training, cultivate a local maker culture, continuously refine and develop the characteristic campus culture, so that innovation and entrepreneurship become a learning paradigm for college students. For example, the maker atmosphere created by the project unit to inherit the "Jinjiang experience" and promote the "Min business spirit" has been well received by the majority of teachers and students.

6.2. Stimulate the Vitality of Maker Subjects

In addition to attracting college students to actively participate in maker activities by cultivating maker culture, it is also possible to strengthen the practical teaching function in integrating professional education and innovation & entrepreneurship education in the talent training plan, increase the proportion of competition awards, set up graduate entrepreneurial awards or support funds to effectively mobilize students' enthusiasm, initiative and creativity in maker space [10]. In addition, the establishment of school-enterprise cooperation platform for maker space, on the one hand, helps to solve the management and technical problems in start-up projects for teachers and students, and accelerate the transformation of ideas into products and markets; on the other hand, perfects the maker motivation system, stimulates the driving force of cooperative enterprises to participate in innovation and entrepreneurship education, further enhances the integration depth and breadth of production and education.

6.3. Focus on the Improvement of Maker Capabilities

The construction of maker space in colleges and universities is inseparable from enterprise-oriented management and market-oriented operation. On the one hand, we should actively explore the multi-subject operation mode created by schools, enterprises and students, boldly introduce professional service agencies, and let excellent entrepreneurs, investors and outstanding alumni participate in the selection, incubation, operation and marketing of maker projects to strengthen operation and service capability. On the other hand, we should strengthen the linkage and cooperation between the campus scientific research platforms and maker platforms, straighten out the property rights and interests distribution of maker achievements, accelerate the transformation from R&D to production and marketing to strengthen innovation capabilities.

Acknowledgements

Fund Project: The Key Research Project of Vocational Education Teaching Reform of Fujian Vocational and Technical Education Center (GA2020001)

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