Research on the Cultivation Model of Innovative and Entrepreneurial Talents with New Technology Use in Higher Education Institutions

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Abstract: The issue of new technology applications in education is a worldwide concern. Following a thorough review of current studies, this paper believes that new technology in a broad sense has "hard technology" (referring to new inventions, discoveries, and creations that can be practically operated and applied) and "soft technology" (generally referring to technology formed in all industry fields in response to new changes, new markets, new industries, and new business models, such as innovative marketing models, new team building, and management strategizing, cultural and creative skills, etc.), with distinctive and external and internal connotations. In a narrow sense, new technology refers to the most recent and cutting-edge technology in a particular industry field. There are also definitions that are based on their applicability, such as referring to new operation methods as new technologies. The premise of how to precisely implement new technology application education in higher education is to understand how students in higher education institutions think. For this reason, this study takes senior graduate students as its target, and through the statistics and analysis of survey data, we get three results. First, education featuring applications of new technology proves highly compelling, particularly given its importance in graduates' career development, thus garnering support; second, such education is both conceptual and practice-based; third, education concerned with the application of new technologies can be carried out in any major, both in engineering and non-engineering disciplines, with different requirements for educational content and technical skills according to the varying disciplines. Based on the

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investigation and analysis, we propose solutions and recommend methods of applying new applications in higher education.

Keywords: Technology Use; Cultivation Model of Innovative and Entrepreneurial Talents; Higher Education

1. Introduction

Since the industrial revolution, new rounds of scientific revolutions have led to the genesis of digital technology, and subsequently, artificial intelligence. Today, technical and economic feasibility are becoming increasingly mature, and applications in all fields are accelerating.

In 2011, Germany proposed the concept of Industry 4.0 for the improvement of product quality through digitalization and intelligence. For its part, China has proposed Made in China 2025, which intends to assist or replace workers through intelligent machines and big data, achieving full intelligence in manufacturing (Wu et al., 2017). Accordingly, "We are entering the era of the second machine revolution. The relationship between humans and machines is likely to change from the previous complementary relationship to a substitution relationship, and people will have to 'race against machines'" (Mcafee, and Brynjolfsson, 2018). However, to handle data technology and artificial intelligence, professionals who understand science and technology are still required, and the development of such talent constitutes a national priority.

Meanwhile, technological applications are disrupting the current industrial structure, production methods, and lifestyles, particularly with the rise of artificial intelligence. For example, examining future labour patterns and occupational growth and decline (Liu, 2017), several researchers have pointed out a current widespread decrease in programmed jobs attended by an increase in jobs related to intelligent devices (primarily non-programmed jobs); jobs in processing and manufacturing, material supply,

and production operations are on the decrease, while jobs in strategy formulation, product design, market development, and the production chain are accelerating. Meanwhile, downstream of the production chain, the number of jobs will dwindle in marketing and after-sales service of low-value products in contrast to an upsurge of jobs in marketing and after-sales service for high-value products; in the production support chain, internal logistics and paperwork processing will see a reduction in the number of jobs while IT support will see an increased number of jobs. As this process advances, several traditional manufacturing jobs will be drastically reduced or even eliminated.

In this context, "Made in China 2025" represents the Chinese government's plan to transform China from a traditional manufacturing power to one that embraces the new international environment and industrial change trends, promoting strides in economic, social, and technological industries. To realize this grand blueprint, the national industrial restructuring must upgrade the entire manufacturing industry, particularly the high-end industries. In this process, higher education institutions are not only tasked with cultivating and training high-end technical talents but also providing direction more generally, leading the battle for industrial renewal and technological innovation.

Clearly, innovation and promotion of applications of new technology require advanced technical human resources. Accordingly, higher vocational colleges and universities must engage in planning and reform in the task of providing the technical talent capable of upgrading China's manufacturing.

2. Literature Review

2.1 Innovative Education Research

In 1999, in response to a new era featuring the advancement of science and technology, the concept of "innovation education" emerged as a trend in China. In particular, a shortening of the information technology update cycle, along with the advent of the knowledge economy has increased the intensity of international competition. Accordingly, the key to meeting these challenges is the cultivation of a large number of qualified and innovative talents, in keeping with the times. As such, the modern Chinese concept of "innovation education" requires the cultivation of innovative spirit and ability (Yang et al., 2005).

"Innovation education" represents the transformation of all aspects of education in order to cultivate human resources employing innovative methods, ideas, initiatives, and content. In this regard, Wang's study establishes several proposals: first, the purpose of such education is to explore human innovation potential, promote spiritual development, cultivate positive personalities, and in general, promote comprehensive, healthy, and harmonious development; second, it should promote innovative consciousness, spirit, and capacity (Wang, 2016).

Still, in Chinese academia, no unified definition exists pertaining to the concept of an innovative education system. Deng considers it to represent a complex combination of systems with innovative education at its core, featuring an intersection of educational factors. Its development entails the integration of policy, financial support, and program support (Deng, 2013). In short, the system of innovative education represents a multi-level system that includes "two major parts: the cultivation mode of innovative talents and the growth environment of talents" (Zhu, 2008). For his part, Li (2006) divides his system construction into five subsystems: target system, concept system, organization system

innovation system, science and technology innovation system, and innovation talent cultivation system.

2.2 Research on entrepreneurship education

Extensively researching entrepreneurship education, social entrepreneurship, and entrepreneurial pathways for college students, Liu and Li (2008) made a comparative study of entrepreneurship education in Chinese and American colleges and universities. Meanwhile, Xiu (2011) introduced relevant initiatives for promoting youth entrepreneurship in foreign countries, such as the Youth Business International (YBI) program, the International Labor Organization's KAB program (Know About Business), the Youth Challenge Program of France, and others. Referring to German youth employment and entrepreneurship work methods and in light of China's circumstances, Ye Jiankui proposed that universities match training to the industrial structure, match career guidance with market demand, and link government leadership to social participation (Ye, 2010). In India, Guda et al. explored also explored entrepreneurship education in that context (Guda et al., 2007).

Meanwhile, Cao and Lei tracked six models of entrepreneurship education in universities. First, Heilongjiang University features a special entrepreneurship school, a series of courses with clear credit requirements, and a mock entrepreneurship lab. Second, Zhongnan University offers general entrepreneurship courses and encourages students to participate in entrepreneurial practice (the "general education + emphasis on practice model"); third, the Central University of Finance and Economics, led by the School of Business, selects students from all majors and offers entrepreneurial pioneer classes (the "elite entrepreneurship program"). Fourth, Tsinghua University's School of Management offers a general course on entrepreneurship management for all majors, a series of entrepreneurship management courses for MBAs, and an entrepreneurship plan competition organized by academic and industrial departments.

Fifth, Wenzhou University, led by independent colleges, offers entrepreneurship courses in conjunction with majors and guides students through a "course + simulation practice model." Sixth, numerous vocational colleges combine entrepreneurship education with career guidance and encourage students to extend their entrepreneurship experiments in school to start their own businesses ("Entrepreneurship-based career guidance + Entrepreneurship Experiment + Extended Entrepreneurship Model") (Cao and Lei, 2009).

2.3 Research on Innovation and Entrepreneurship Education

Some scholars have compared training models, noting that training models in European and American universities include the aggregation model, magnet model, radiation model, and so on, whereas Chinese universities possess classroom models, practice models, integrated models, integration models, and so on (Li, 2008). Several academics have also proposed a "progressive" model of training in entrepreneurship in colleges and universities (Lu, 2011), made up of three relatively independent but interconnected stages: entrepreneurship foundation education, entrepreneurship practice education, and entrepreneurship support (Wang, 2012).

Several academics advocate for university-wide entrepreneurship education, which includes all students, draws on all university resources and aims to cultivate students' entrepreneurial spirit and capacity. Accordingly, school-wide entrepreneurship education is divided into three stages: quantitative growth in the primary stage, organizational transformation in the intermediate stage, and conceptual penetration in the advanced stage (Mei, 2012). Several Chinese academics divide development goals for "innovative and entrepreneurial talents" into "innovators," "entrepreneurs," and "innovative entrepreneurs."

According to some scholars, China's entrepreneurial training system is still in its early

stages, and it currently taking the form of general education courses, minor programs, or entrepreneurial practice, among others. Still, according to many, further consideration should be given to the development of a curriculum system and a degree system (Mei and Meng, 2016).

In general, Chinese scholars believe that cultivating entrepreneurial human resources must be rooted in an effective educational concept and a dynamic educational system (Gong et al., 2003). In ancient times, Confucius advocated "teaching students according to their abilities". In modern China, research on innovative and entrepreneurial education has only been conducted for forty years, beginning in 1979 with Wang Gong's book "The Mystery of Scientists' Success."

Subsequently, more academics began to investigate the development of innovative and entrepreneurial skills.

Gong et al. presented a novel concept for the cultivation of innovative and entrepreneurial capacities in "Exploration of the Concept of Innovative Talent Cultivation." He proposed establishing a purposeful educational perspective on comprehensive personality development; implementing education and teaching methods compatible with the personalized development of innovative and entrepreneurial talents; and establishing a diverse and dynamic teaching evaluation system (Gong et al., 2003). Meanwhile, in "Innovative and entrepreneurial talents cultivation should focus on personalized development and diversified education", Tang (2006) proposed that the education system should alter its focus, shifting from teacher to teacher and management system and from rigid and dull to flexible and diverse.

According to Jia Yanfeng, Li Yueyun, and others in "The inherent deficiencies of the current innovative and entrepreneurial talent cultivation model and its improvement," the reform of the innovative and entrepreneurial talent cultivation model primarily begins with adjusting and reforming the system of the curriculum; linking education with regional characteristics; constructing an open practical teaching platform; constructing an "open talent cultivation model"; and integrating innovative technologies (Jia et al.,2013).

2.4 New technology applications and innovative and entrepreneurial talents

According to Christensen, Clayton M., new technologies may be classified into two types: disruptive technology and continuity technology (Clayton and Overdorf, 2000). However, in 2006, Clayton et al., (2017) broadened the definition of disruptive innovation to include both disruptive technology and disruptive business models.

In Prescription for Innovators: How disruptive innovation is changing healthcare, Christensen formally defined business models as comprising four components: customer value proposition, profitability model, key resources, and key processes. Furthermore, in 2004, Clarysse and Moray proposed a linear sequential development model of innovative entrepreneurship of new technology. This model illustrates the initial development process and capability evolution mechanism of technological entrepreneurship from four perspectives: basic research, technological innovation, technological development, and commercial development, providing useful theoretical references for subsequent research on the process model of new technology commensurability (Clarysse and Moray, 2004). Meanwhile, in this year's related research, Vohora and Wright proposed a linear reciprocal development model of innovative entrepreneurship of new technology, conceptualizing the technological entrepreneurship process as comprising five stages: technological development, opportunity locking, organizational preparation, repositioning, and continuous growth, and sequential development (Vohora and Wright, 2004).

According to Leighton Christensen, two categories of new technologies exist, one being disruptive technology and the other being continuity technology. The learning and use of new technologies discussed in this paper focus on the learning and use of continuity technologies and the application of the learned new technologies for the purpose of facilitating professional careers. The emphasis on the integration of learning and application of new technologies in innovation and entrepreneurship education for students of higher education is due to the fact that students higher education can often acquire stronger skills through systematic learning.

3. Methodology

In recent years, official data reflects unpromising employment matching for senior vocational graduates, at rates ranging from 40 to 66 per cent, raising concerns regarding higher vocational students that do not excel at their studies. Consequently, this study employs a self-administered questionnaire to graduate students of Wenzhou Vocational Institute of Technology with the ultimate aim of contributing to the cultivation of experts in the application of new technology. Several students from this institute have started their own businesses; others have launched their own businesses but failed to persist; meanwhile, others have grown into excellent managers in an enterprise; still others, many years beyond graduation, continue to experience rough career development; still, others have abandoned their majors and are employed in a different occupation. The professional distribution of the survey subjects covers a wide range of disciplines. 152 valid questionnaires were collected.

4. Data analysis

4.1 Awareness of "education and learning of new technology application" among graduates proves weak

We examined whether the graduates' attitudes

toward "new technology education" differed among different income levels (lower income, middle income, and higher income). We also set a maximum score of 5 for each graduate's attitude toward "new technology education," indicating the most supportive attitude. We also set the annual income of graduates below \$50,000 as lower income, between \$50,000 and \$100,000 as middle income, and above \$100,000 as higher income. The data obtained from the statistics are shown in Table 1.

The overall mean scores and standard deviations were as described earlier. Through comparisons with the other data, it can be seen that the mean scores of attitudes toward "new technology education" proves similar across the income groups, and the standard deviations are approximately the same. Further analysis of variance (ANNOV) for the three groups (lower income, middle income, and higher income) yielded Table 2.

The significance level of 0.125 is greater than 0.05, which is also non-significant, indicating no significant difference between graduates of different income levels in terms of attaching importance to "new technology education"; for example, no situation arises in which graduates with high incomes agree very much while those with low incomes disagree

Table 1 Statistics on the attitude of different income levels toward "new technology education"

Graduates	Mean score	Standard deviation	
Lower	3.34	0.745	
Higher	3.33	0.516	
Moderate	3.70	0.470	
Total	3.43	0.680	

Table 2 Summary of ANOVA by "income" group

	Sum of squares	Mean squared	F	Significance
Difference between groups (by speciality)	1.918	0.959	2.137	0.125

very much. An in-depth analysis of this phenomenon demonstrates a lack of awareness concerning new technology mastery and its relationship to job acquisition, income, etc. This also represents a negative consequence of the lack of attention to learning new technology in higher vocational education over the years, a point worthy of reflection by these institutions.

4.2 High recognition of "strengthening new technology education in higher education" among higher vocational graduates

The variations of graduates' views on "strengthening new technical education in higher education" are shown in Table 3.

Table 3 Differences in agreement on new technical education in higher education

Classification of the degree of importance	Percentage of graduates choosing (%)
Very Important	51.32
Important	43.42
Not necessarily	2.63
Not important	2.63

According to the above data, it is necessary to "strengthen the education of new technology in higher vocational education", and the percentage of graduates who think that higher vocational technology should be at the forefront of professional education represents more than 50%, while the percentage of graduates who think that "strengthen the education of new technology in higher vocational education" is important, and the percentage of graduates who think that higher vocational students should learn some new technology is more than 30%. The proportion of those who think that "learning basic professional knowledge and skills" is more important and "strengthening higher vocational new technology education" is not so important is not more than 30%. The proportion of those who think "learning basic professional knowledge and skills" is more important and "strengthening new technical education" is less important and does not exceed 10%. According to the statistical analysis, the correlation coefficient of each option is 0.953, which is highly positive, indicating that the distribution of the importance of "strengthening new technical education in higher education" is highly consistent. Virtually all students believe that it is highly necessary to "strengthen new technology education in higher education."

- 4.3 Thematic analysis of survey papers of senior graduation students
 - (1) Higher education imprints of senior graduates

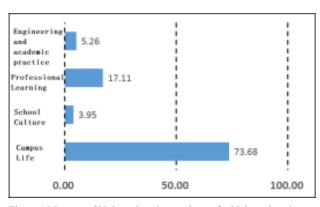


Figure 1 Memory of higher education graduates for higher education

The data in Figure 1 shows that the content that leaves the most profound memory for most senior graduate students in campus life, accounting for 73.68%, followed by professional learning, engineering practice, and school culture. On the one hand, this shows that students are attached to campus life. On the other hand, it also shows that knowledge learning and skills learning do not leave a deep enough impression on students, especially the influence of school culture.

(2) The most useful education for senior students

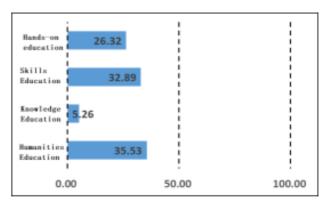


Figure 2 The most used educational content at the senior level

As can be seen from Figure 2, graduating students consider humanities education to be the most useful for their future working life, followed by skills education and practical education, both accounting for about 30%, while knowledge education only accounts for about 5.26% of the choices. During the study period, the examination is largely concerned with knowledge, and "knowledge education" has a high status. Once students leave school and enter society, the social nature of people will be enhanced, and education grows less important.

(3) The main factors affecting professionalism

As can be seen from Figure 3, the most essential factors impacting the growth of professionalism are not basic skills (14.47%) and professional theories (10.53%), but innovative ability (36.84%) and new professional technologies (38.16%). Innovative ability and new professional technology both have the word

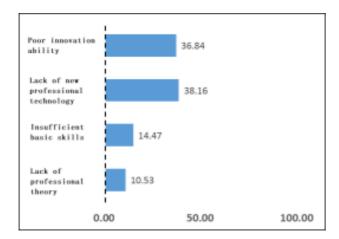


Figure 3 The biggest factors affecting professional growth

"new" in them; to adapt to the dynamic changes in social needs and job demands, graduates need to learn new technologies and new techniques. The distribution of options shows that students wish to focus on these competencies during their school years.

(4) The powerful point of higher professional education

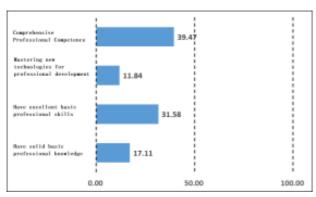


Figure 4 The most important factors for professional development

The proportion of data shown in Figure 4 reveals that more than 70% of the respondents hold that "comprehensive professional competence" and "excellent basic professional skills" constitute the most important training directions for professional development. The proportion of those who hold that "having solid basic professional knowledge" and "mastering new technologies of professional development" is the most important training direction for professional development is less than 30%. This

signifies that the majority of students consider the comprehensive ability and basic skills to be the most important training directions for professional development in the context of their own work experience.

(5) Factors affecting the employment matching rate

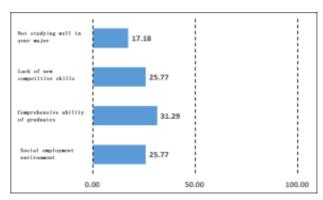


Figure 5 Key issues of low professional matching rate of employment and entrepreneurship

Indisputably, the professional matching rate of higher vocational students' employment and entrepreneurship remains low. The data in Figure 5 shows that students believe several aspects, not a single factor, cause this phenomenon. Among them, the "comprehensive ability of graduates" is the most selected factor, accounting for 31.29%.

(6) Views and opinions of graduating students on new technical education in higher education

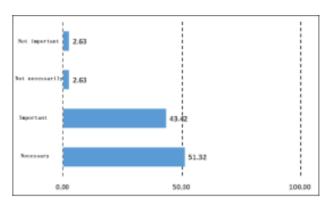


Figure 6 Opinions and views on enhancing new technology education in higher education

The data in Figure 6 demonstrate that most graduates consider it necessary to "strengthen new

technical education in higher education". The sum of "important" and "very necessary" is as high as 94.74%. Students also believe that professional technology should be taught at the forefront of higher vocational education; nor is it enough for higher vocational students to learn only the basic skills of the profession; they should acquire updated information about the profession and technological skills. Only 5.26% of the students think that "new technology" should be learned after graduation, and only 5.26% believe that "basic professional knowledge and skills" should be acquired in higher vocational education.

(7) New technology education pathway methods

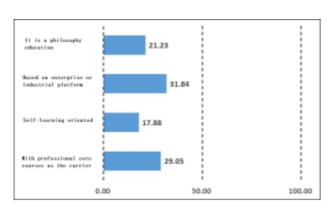


Figure 7 Thinking about the path and methods of new technical education in higher education in conjunction with professional experience

The data in Figure 7 demonstrates that graduates, considering their own professional experience, believe that the path and modality of "higher vocational new technology education" should be multi-faceted. Firstly, it should not only be based upon enterprises or industrial platforms, but it should include new technologies through the integration of industry and education (31.84%); secondly, it should be carried out in combination with the core curriculum of majors and with teachers as the leaders (29.05%); at the same time, "higher vocational new technology education" should constitute a basic mode of education and permeate all educational activities (21.23%); meanwhile, it should be carried out through the Internet information technology platform, and independent learning should be carried out through the

internet information technology platform (17.88%).

(8)Difficulties of new technology education

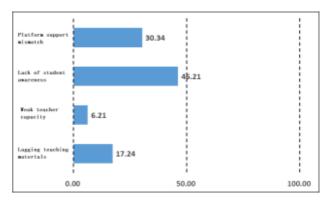


Figure 8: Main difficulties in enhancing education on new technology applications

According to the data in Figure 8, graduates believe that the main challenge in strengthening education relevant to applications of new technology is "insufficient student awareness" (46.21%), followed by a mismatch in platform support (30.34%), a lag in teaching materials (17.24%), and a lack of teacher capacity (6.21%). Therefore, to strengthen the education of new technology applications, it is necessary to start by strengthening students' awareness of "new technology" while building a corresponding educational platform.

(9) Guarantee of new technology education

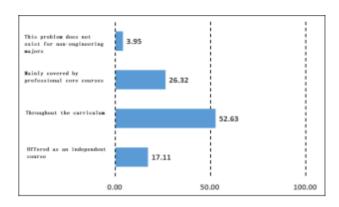


Figure 9 Presence model of education on new technology applications

According to the data in Figure 9, "new technology application education" ought to be integrated throughout the curriculum (52.63%), both primarily integrated with the major's core courses

(26.32%) and offered as a separate course (26.32%).

5. Discussion

5.1 Higher vocational new technology application education is the inevitable way for the internal development of Chinese higher vocational education

One of the major missions for vocational education in the new era is to make China strong in vocational education. To take up this mission in conformity with the development of the times while promoting the national development strategy, vocational education must unquestionably cultivate new talents and strengthen the quality of talents through new technology.

5.2 Higher vocational new technology application education represents a comprehensive and entire process

Through investigation and argument, this thesis has generated a new interpretation of the contemporary Chinese concept of "new technology application education." For an extended period, new technology has been narrowly considered as the province of engineering, which tends to exclude non-engineering majors from the responsibility to learn new technology, resulting in a serious disconnection between talent cultivation and social demand. Through questionnaires and empirical experiments, this study reveals the need for a "new technology education" in higher vocational education in China that is more comprehensive and contemporary.

5.3 Exploring the mode of higher vocational new technology application education

Based on the analysis of relevant literature, combined with case study analysis and empirical experiments, this thesis may serve as a model for "new technology application education" in higher education. Systematic research has been conducted on target orientation, path method, implementation process, and

quality assessment, which make it more serviceable and referenceable and paves the way for utilization of its results.

6. Limitations

Several problems in this study remain, such as the precise means of improving new technology application education across the curriculum, how to formulate the basic guidelines in specific majors, and how to build optimal practice platforms, among others. Therefore, additional research is required.

7. Conclusion and future research

Education in the application of new technology is a socially connected and open form of education in China. At the moment, the most difficult aspect of new technology applications is not exclusive to school-related issues of updating concepts, improving facilities, providing teacher training, and other issues, but also relates to the development of experimental platforms.

According to this thesis, creating "three platforms" for new technology application education is critical. Specifically, we must precisely match development needs, carefully plan education and teaching reform, and cultivate and improve service capacity. In other words, we should deepen the "integration of industry and education" to solve the problem of fitting education to the demands of industry; conduct investigations of talent cultivation with new technology applications to foster careful planning of education and teaching reform; and insist on "ground-based" technology application research to solve the problem of improving serviceability.

We should strive to create three higher vocational education targets: the target of industry-education integration, the target of new technology application talent cultivation, and the target of "local" technology application.

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