

Research on the Innovation and Entrepreneurship Integration Teaching Reform in Medical Colleges and Universities Based on the New Medical Science

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Abstract

This study reviews the relevant literature on the education reform of medical innovation and entrepreneurship, analyzes the challenges that the Chinese higher medical education needs to face, including the organic integration of interdisciplinary knowledge, the in-depth integration of professional education with innovation and entrepreneurship education, the sustainable development of innovation and entrepreneurship education, and the lack of innovation and entrepreneurship education management system. In terms of the construction of innovation and entrepreneurship laboratories, a large number of projects based on the medical innovation and entrepreneurship education has been carried out in China. However, there is no relevant requirement for the teaching goal of the medical innovation and entrepreneurship education in The United States, which has led to the lack of teaching goal in American medical education, thus their medical innovation and entrepreneurship education emphasizes participation rather than the result, and it is an aspect that China should learn from. Finally, this study analyzes three aspects including the lack of the system, the insufficient combination of professional education with innovation and entrepreneurship education, and the teaching management concept, and puts forward the countermeasures for improving the construction of innovation and entrepreneurship integration system, deepening the reform of medical course, and the innovation of medical management mechanism, which aims to provide reference for the innovation and entrepreneurship education in Chinese medical colleges and universities based on the new medical science.

Keywords

New medical science; Innovation and entrepreneurship education; Teaching reform.

1. Introduction

In response to the new requirements for medical education, medical education reform was put on the agenda of the Chinese government. The new medical department has proposed a new concept of prevention and treatment, life-long health, especially in medical education institutions. New majors such as digital medicine, transformation medicine and intelligent medicine need to be established, requiring medical education to actively embrace the opportunities and challenges of the new science and technology revolution and industrial change [1]. In response to the present situation of China's higher medical education, the Ministry of Education has accelerated the implementation of the "Six Excellent Points" plan,

which emphasizes the construction of new engineering, new medicine, new literature and new agriculture [2]. Actively exploring a new medical personnel training system in line with the needs of the new era has posed new challenges to the current reform of higher medical education in China. On December 29, 2018, the Joint Meeting of the Medical Specialty Teaching Steering Committee of the Ministry of Education of The People's Republic of China, and the First Working Meeting of the Clinical Medicine Specialty Teaching Steering Committee were held in Beijing, where systematic planning was made to actively accelerate the construction of new medical departments and cultivate outstanding medical scientists in the future. According to the meetings, a new mode of medical education supported by medical humanities, medical engineering, medical science should be established under the background of global Industrial Revolution 4.0[3]. In "Excellent Doctor Education Training Plan" and "Top Students Test Plan for Basic Subjects", it is suggested to establish biomedical research platform and training base of medical talents on the basis of actively exploring new technological revolution represented by artificial intelligence, and the interaction between industrial revolution and construction of "new medicine" and other systems. In addition, the new medical education system with Chinese characteristics has been comprehensively integrated into the burgeoning new medical fields such as precision medicine and translational medicine, which is able to adapt to the new generation of technological revolution represented by artificial intelligence and the life science revolution represented by synthetic biology. High-level medical innovative talents who can flexibly apply interdisciplinary knowledge to the solution of cutting-edge problems in the future medical field are needed. Therefore, in the context of new medical science, how to carry out the organic integration of innovation and entrepreneurship education with specialties in medical colleges and universities has become an important topic of current medical education and teaching reform in China.

2. Literature Review

2.1. Domestic Research Status

China's economic development has entered a new era, and medical education has also presented its importance in education reform. Starting from the grand strategy of the 14th Five-Year Plan, the CCP and state leaders have decided to accelerate the implementation of the innovation-driven new medical development strategy. The innovation and entrepreneurship education is an important way to carry out the innovation-driven development strategy, and its urgency has been increasingly highlighted. In recent years, new policies on innovation and entrepreneurship education have been put forward one after another. The plan of "Double First-Class" construction with great social influence emphasizes on strengthening the knowledge structure of students' innovation and entrepreneurship [4]. Some colleges and universities regard innovation and entrepreneurship education as an important entry point for deepening the reform of talent training and improving the quality of talent training. They have made positive practice attempts and achieved obvious results. However, some problems still exist in professional education as well as innovation and entrepreneurship education, including concept confusion [5-8], lack of teachers [9-11], unreasonable curriculum [12-14], unsound security system [15-17] and low degree of professional education integration[18-20]. China's innovation and entrepreneurship education has been carried out in an all-round way in the higher education system, mainly in the following seven areas: 1. University laboratory construction; 2. Practical basis; 3. Scientific research training for college students; 4. University entrepreneurship education; 5. Employment and entrepreneurship guidance; 6. Credit system reform; 7. College education platform. Aljohani (2015) analyzed the importance of innovation and entrepreneurship in modern education and society, and put forward the definition and content standards of innovative entrepreneurship education. Some scholars [21-24] believe

that advanced experience in education institutions is an important way to promote the development of higher education. Ji Xuejun [24] introduced the experience of innovation and entrepreneurship education in Silicon Valley. These literatures mainly focus on the introduction stage of innovation and entrepreneurship education research. In 2007, China Association of Higher Education held a seminar to discuss the development direction of innovation and entrepreneurship education [25]. Gao, Yan and Gang [13] put forward the systematic framework of the innovation and entrepreneurship education in colleges and universities, which was divided into four types: general education, embedded education, professional education and vocational education. Some scholars [14] believe that there are several contradictions in entrepreneurship education in China. For example, the subject positioning of innovation and entrepreneurship education in colleges and universities is vague and broad, the curriculum content system is not perfect, and many institutions lack professional teachers. It is generally believed that the main problems in the implementation of innovation and entrepreneurship education in colleges and universities are the separation from professional education [19, 26, 27]. These scholars analyzed innovation and entrepreneurship education mainly from the aspect of curriculum construction. Some scholars studied the methods of innovation and entrepreneurship education. Song [28] called for the introduction of teaching methods in the field of entrepreneurship education. Zhanren [29] conducted exploratory practical research in combination with the teaching objectives and methods of innovation and entrepreneurship education. Harkema and Schout [30] introduced a learner-centered approach to innovation and entrepreneurship education in which students are the driving force in learning process. Yan, Wei, Meng, Dan, Teng and Lu [31] established an innovation and entrepreneurship education model suitable for Chinese college students. Liu [32] emphasized the renewal of the concept of innovation and entrepreneurship education, the construction of a scientific and reasonable curriculum system, the strengthening of the infiltration and integration of vocational education, and the establishment of an effective teaching quality evaluation system. These scholars focus on the construction stage of concept and evaluation mechanism for innovation and entrepreneurship education. Innovation and entrepreneurship education in China is in the midst of both conceptual (new model of entrepreneurship education) and technological (e-learning, mobile devices, learning networks, entrepreneurial networks) changes caused by global, social, political and technological upheaval [33]. Innovation and entrepreneurship education has shown initial success in universities and are mature in some developed countries. However, until 2014 when Chinese Premier Li Keqiang highlighted innovation and entrepreneurship as the country's key growth drivers, the innovation and entrepreneurship education reform was officially put on the agenda in China. The aim of this reform is to improve the quality of higher medical education in China, enhance the innovation ability of medical students, and improve their employability and employment quality [34]. In view of this, the Chinese government has introduced a number of policies and measures to continuously strengthen the cultivation of college students' innovative and entrepreneurial awareness and improve their practical, innovative and entrepreneurial ability, thus scientifically and rationally promoting the comprehensive teaching reform of medical colleges and universities and improving the quality of higher education. The Mid - and Long-term Youth Development Plan of China (2016-2025) was fully launched in 2017, emphasizing the establishment and improvement of an innovation and entrepreneurship education system, the combination of teaching and practice, as well as the combination of innovation and entrepreneurship education with professional education in the process of innovation and entrepreneurship education. It can be seen from the domestic literature review that there are still some research gaps in innovation and entrepreneurship education in medical colleges and universities at present, such as the organic integration of medical professional

education with innovation and entrepreneurship education, and the relevant domestic research literatures are limited at present.

2.2. The Status Quo of Overseas Research

Since the 15th century, the importance of innovation and entrepreneurship for social development has been affirmed and discussed by scholars around the world (Schumpeter, 1912). At present, the discussion on innovation and entrepreneurship education is still the subject of educational administrators [35-37]. All universities are inseparable from the integration of innovative education with professional education, for the reason that innovation not only promotes the continuous improvement of professional and technical education methods, but also promotes the reform and development of professional and technical education. The orientation of professional technical education is skill and professional knowledge, emphasizing students' practical ability, and knowledge and skill level to meet the needs of the upgrading of emerging industries as well as social and economic development. With the development of a series of reform projects such as innovation and entrepreneurship, especially vocational education reform in many developed countries, effective educational results have been achieved [30, 38]. In particular, innovation and entrepreneurship education in the United States has a history of more than 50 years, and was first carried out by Harvard University in 1947. In the following two years, Stanford University also began to implement innovation and entrepreneurship education. After several years of training, a large number of innovative and entrepreneurial talents were cultivated and sent across the United States [39].

In terms of the reform and development of medical technical innovation and entrepreneurship education, the United States attaches importance to the cultivation of innovative thinking. Professional medical technology entrepreneurship education is not only knowledge transfer, but also the promotion of knowledge creation and knowledge practice. It's not just about cognitive knowledge in science, but about the ability to identify new opportunities and the entrepreneurial creative process, and the ability to inspire entrepreneurship [40]. Innovation and entrepreneurship education in the United States has largely been benefited from the educational reforms initiated by business schools and administrative departments, as well as higher education institutions. With their own characteristics and the technical innovation system with hardware and software conditions, medical colleges and universities carry out the connection of medical professional education with innovative ideas. Faced with the constant innovation of medical technology and the rapid change of disease spectrum, the current education of American medical colleges and universities cannot meet the new needs of students for innovation and entrepreneurship. The continuing emergence of innovative technologies and systemic changes in personalized medicine, regulations and reimbursement models present immediate and uncertain challenges to physicians outside the basic and clinical sciences, including traditional medical education. Addressing these new challenges requires not only clinical knowledge but also the ability to design, develop and implement patient-centered solutions to complex problems. Both the Association of American Medical Colleges (AAMC) and the American Medical Association (AMA) recognize system-level problem solving as a basic requirement for medical graduates, but little agreement has been made on the critical skills and knowledge needed to achieve this goal. Innovation and design-related education has emerged as a potential source of new teaching methods and concepts to address the need for medical skills in medical education [41].

Many medical schools in the United States have begun to introduce formal courses to develop students' ability to solve complex problems. These innovation - and design-related projects vary in forms and scales, and often fall within the realm of innovation and entrepreneurship. Historically, innovation and entrepreneurship has been developed in undergraduate programs that focus on business or product development, however, now it becomes a common field for

graduate students in business, engineering, and design. As innovation and entrepreneurship courses have permeated medical education, further research is needed to understand how they complement medical courses and what inspiration it may provide for future medical education. There is no doubt that doctors will be called upon to help solve current and future challenges in the health care system. When doctors take a leading role in developing products and solutions to complex problems, innovation and entrepreneurship education can provide relevant information. Medical information education is a new concept of medical education. It is a challenge to give a clear and concise definition of medical innovation education. Some definitions, such as those in the framework of medical innovation and entrepreneurship, generally regard medical innovation and entrepreneurship as the ability to turn ideas into action. Other competency models include structured medical problem solving, needs analysis, and social orientation and technical skills such as financial analysis. In this paper, innovation and entrepreneurship education is defined in the most general sense, which is the process of learning how to generate ideas and turn those ideas into defined goals, such as products or initiatives. In doing so, the key skills and concepts can be identified to help medical students engage in complex problem solving in their future careers.

A systematic search was conducted on 158 course websites of the American College of Allopathic Medicine to identify relevant innovation and entrepreneurship courses. Keywords used to identify programs include innovation, entrepreneurship, design, technology, invention, focus, trajectory, curriculum, and Apex Projects. The programs that can be included in the research should meet the requirements including having clearly defined curriculum objectives consistent with the above principles of innovation and entrepreneurship, are officially approved by their medical school, and are not existing as isolated electives. To identify additional items that were missing from our search, the directors of included programs reviewed the compiled list and were given the opportunity to add items that were not included. It should be noted that programs are identified through the AAMC Curriculum Directory and Report (CIR), a public repository of medical school curriculum data. However, it was found that innovation or entrepreneurship are not mentioned in the AAMC and CIR [24, 42]. In addition, the data obtained through CIR is aggregated in nature, which does not allow us to discern enough detailed information about individual programs. Therefore, the programs can be identified through the website search and project director recommendation mentioned earlier. The summary is as follows:

Table 1. Innovation and entrepreneurship education programs in American medical colleges and institutions

Medical colleges and institutions	Name of I&E programs
Warren Alpert Medical School, Brown University (BROWN)	Concentration in medical technology, innovation and entrepreneurship
School of Medicine and Health Sciences, George Washington University (GWU)	Clinical practice innovation and entrepreneurship track
School of Medicine, New York University (NYU)	Health systems innovation and policy concentration
Feinberg School of Medicine, Northwestern University (NU)	NUvention: Medical
Sidney Kimmel Medical College, Thomas Jefferson University (TJU)	College within the college design track
College of Medicine, University of Arizona (UA)	Leadership and innovation in healthcare distinction track
College of Medicine, University of Illinois at Chicago (UIC)	Innovation medicine program
Medical School, University of Michigan (UM)	Innovation and entrepreneurship path of excellence
Perelman School of Medicine, University of Pennsylvania (UPENN)	Certificate in healthcare management, entrepreneurship, and technology
Keck School of Medicine, University of Southern California (USC)	Health, technology and engineering program
Morsani College of Medicine, University of South Florida (USF)	Innovation, entrepreneurship and business in medicine scholarly concentration
Dell Medical School, University of Texas at Austin (UT)	Health care innovation & design distinction
School of Medicine, University of Virginia (UVA)	Human-centered design and medical innovation program

From the above medical colleges and the fusion of innovative entrepreneurial programs, it can be seen that the integration of American medical education and innovation education mainly concentrates in the programs. It is not a patchwork with different pieces, but a natural process of innovative undertaking and the integration of professional medical education, providing positive thinking and reference for the development of the programs. Surprisingly, the resources from organizations like the AAMC and AMA have not yet focused on innovation entrepreneurship or program-specific courses. The innovation and entrepreneurship programs of American medical education institutions are summarized and analyzed. This study will provide basic resources for medical educators, thus providing reference for innovation and entrepreneurship medical education in China.

3. Theoretical Foundation

According to situational learning theory, learning is not only a psychological process of individual meaning reconstruction, but also a social and practical process of participation mediated by different resources. The learners' own cognition and role in the interaction between learners and learning situations, as well as the communication among learners in the learning process are important factors to affect learning, thus the creation of learning environment can exert impact on the learners' identity and role awareness to help them complete life experience and cognitive task, and integrate into social reality, thus solving the problems of traditional medical education institutions [43]. Medical innovation and entrepreneurship education is an organic integration of multiple knowledge and skills with a comprehensive interdisciplinary teaching. How to create the integration of professional education with innovation and entrepreneurship education, as well as the integration of ideological and political education with innovation and entrepreneurship are the most challenging problems. China's medical colleges and universities should fully implement the country's important deployment on training innovative and entrepreneurial talents. According to the opinions of The General Office of the State Council on Deepening the Reform of Innovation and Entrepreneurship Education in Higher Education Institutions (No.36, 2015) and the notice of The General Office of the People's Government of Guangxi Zhuang Autonomous Region on Printing and Distributing the Implementation Plan of Deepening the Reform of Innovation and Entrepreneurship Education in Higher Education Institutions (No.50, 2016, Guangxi Administration Office), the guiding principles of the 19th CPC National Congress under the guidance of Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era should be fully implemented [1]. The national education policies should also be fully implemented to strengthen moral education and professional education, adhere to the principle that innovation leads the entrepreneurship, while entrepreneurship creates more employment opportunities, and actively adapt to the new social development. Quality education should be further carried out to promote value creation and innovation entrepreneurship education in medical colleges, where students' initiative spirit, creativity, as well as innovation and entrepreneurship ability can be cultivated. Based on the development of regional medical and health undertakings, the integration of innovation and entrepreneurship education with professional education in medical education institutions should be carried out and developed, aiming to serve the local regional economy, contribute to the construction of ASEAN "The Belt and Road", build Guangxi regional large health industry group and cultivate high-level medical and health talents.

4. Analysis

At present, there are three main problems in innovation and entrepreneurship education in Chinese medical colleges and universities:

4.1. Institutional Functions Are Limited

Innovation and entrepreneurship education in Chinese medical colleges and universities started late. In addition, at present, the practice venues are limited and students do not have sufficient opportunities for practice. Theoretically there are still many shortcomings [15]. Medical students know little about financial management, operation management, market management and strategic development in business, and lack the overall grasp and control of innovation and entrepreneurship. Most of the entrepreneurship training programs do not have follow-up development and implementation after the completion of the programs, coupled with the lack of business practice base, thus the concept of innovation and entrepreneurship is difficult to be rooted in the mind of college students [27]. Lacking follow-up development and incubation, most projects are short of sustainability and continuity of development. Therefore, the atmosphere of innovation and entrepreneurship in medical colleges is not strong, and the motivation of innovation and entrepreneurship and the cultivation of team are restricted to a great extent.

4.2. Innovation and Entrepreneurship Are Not Closely Integrated

Teachers in medical colleges and universities do not know how to face innovation and entrepreneurship education as the students do not have physician certificates. In medical colleges and universities, the professional medical students must participate in the relevant medical examination and standardized training, and only by taking the training and passing the examination can they obtain the professional qualification certificates. College students' innovative and entrepreneurship education in medical education institutions are facing serious challenge, therefore, in the medical professional education field, innovation and entrepreneurship education are restricted by a number of objective factors, and students are difficult to have a thorough understanding of the professional knowledge related to innovation entrepreneurship, which affects the construction of the teaching team in medical colleges and the development of innovation education [13]. On the other hand, the integration of professional education with innovation and entrepreneurship education, as well as the integration of ideological and political education with innovation and entrepreneurship education in medical colleges are limited by the specialty and lack of innovation. The preciseness and standardization of medical profession hinder the development to some extent. There are obstacles in cultivating students' divergent thinking and innovative thinking, some good ideas cannot be recognized, and the potentialities of students cannot be effectively tapped and protected. Some others are informed before applying for patents, missing the optimal period.

4.3. Management Concepts Are Outdated

The definition of innovation and entrepreneurship is considered by some professional teachers as heretical ideas and are misinterpreted, thus they believe that it has nothing to do with their studies [15]. In fact, innovation is the foundation and entrepreneurship are the goal. Innovation means that after college students deliberate on their specialty, they make a deep exploration on it to make original innovation, introduce innovation and improve innovation, in order to pursue a better life quality. Entrepreneurship not only includes business, but also pays more attention to the entrepreneurial spirit, which includes courage, resourcefulness and wisdom. This spirit requires college students to make further explorations on science and technology and understand that science is the first productive force. Therefore, it is one of the important tasks to reform the management concept of medical education administrators to carry out innovation and entrepreneurship education [25].

5. Countermeasures and Methods

5.1. Improving the System for Integrating Innovation and Entrepreneurship

5.1.1. Improving the Organizational System for Integrating Entrepreneurship and Innovation

A special work group for promoting the innovation and entrepreneurship education should be established to guide, organize and coordinate the building of innovative entrepreneurship institutes, practice venues, and offices. The Youth League and other functional departments as well as all kinds of secondary schools, should cooperate in the daily innovation entrepreneurship education activities to form a work mechanism linkage. The awareness of the responsible departments should be enhanced, and the completion of the work for entrepreneurship and innovation should be evaluated and taken as the target of department work performance [15].

5.1.2. Improving Mechanisms to Ensure the Integration of Entrepreneurship and Innovation

First, medical colleges and universities should guarantee the practical activities of entrepreneurship and innovation integration. They should not only provide support of funds, venues and equipment, but also provide technical guidance, market docking and policy consultation for entrepreneurship and innovation integration. Second, the quality of teachers should be ensured for the integration of business startups and innovation. The teachers for the integration of business startups and innovation mainly consist of on-campus professional teachers, full-time business startups and innovation instructors, and part-time teachers. For on-campus professional and full-time teachers, their theoretical and practical training on the integration of business startups and innovation should be strengthened, and they should be encouraged to go into the frontline of enterprises for professional practice. Part-time teachers, such as successful entrepreneurs, outstanding alumni and innovation experts from outside the campus, are invited to guide the integration of entrepreneurship and innovation on campus to form an innovation and entrepreneurship teacher team, which is a "combination of professional teachers and part-time teachers, as well as a combination of education institutions and enterprises" [17].

5.1.3. Establishing An Incentive Mechanism for Student Entrepreneurship and Innovation Integration

First, the recognition system of innovation and entrepreneurship credits should be improved. Students can apply for innovation and entrepreneurship credits if they participate in various entrepreneurial activities, win prizes or receive awards in entrepreneurship competitions or obtain invention patents, etc. If they engage in innovation and entrepreneurship projects that are in combination with their own majors, the recognized credits can be appropriately increased. Second, reasonable performance can be given to teachers who are engaged in entrepreneurship and innovation activities, and incentives can be provided in terms of rewards and bonus points for professional title evaluation, in which way the integration of professional education with innovation and entrepreneurship education can be spontaneously promoted. [44]

5.2. Deepening the Reform of Medical Curriculum

5.2.1. The Reform of Student Entrepreneurship and Innovation Integration from Overlapping Goals to Coupling Goals

Medical training goal is an important index to determine the quality of innovation and entrepreneurship integration. The compatibility relationship determines the strength of the integration of innovation and entrepreneurship education [13]. Since the interdisciplinary

entrepreneurship and innovation entrepreneurship education are often included into the university education system as a general education course, the training objective is more highlighted in the stage of general education, while it is blurred or mechanically accumulated in the professional education stage, thus the medical talent training scheme needs to be revised, the related statements of innovative entrepreneurial training goal should be introduced. The principle of compatibility between quality and quantity indicates that, in order to realize the integrated development of medical professional education with innovation and entrepreneurship education, the cultivation goals of the two are not simply linear superposition. Their correlation degree should be improved, and they should express each other to achieve multiple coupling. Therefore, making dynamic changes to the medical professional talents scheme requires the investigation of the corresponding medical professional post requirements, and the analysis of the demand of talents in innovation and entrepreneurship education. It also requires the accurate positioning of the core competence of the corresponding medical professional talents, quality objectives, and training goals that are rooted in medical specialty, as well as the target system of the innovation and entrepreneurship education [14]. On the basis of the professional training target and education target, specific decomposition and refinement should be carried out to guide, respect, and arouse the creativity of medical students, with the medical professional ability training being the specific direction. The integration of professional education goals and innovation and entrepreneurship education goals should be optimized and differentiated. Standard requirements including innovation and entrepreneurship awareness, ability and quality should be penetrated in various stages of education theory and practice.

5.2.2. Student Entrepreneurship and Innovation Integration: From Curriculum Patchwork to Curriculum Reconstruction

Medical curriculum is the core of medical personnel training. Plans and arrangements should be made for the symbiotic field of professional education as well as innovation and entrepreneurship education to determine the scope of teaching content, tasks and requirements. Currently, the innovation and entrepreneurship education of many medical majors is dominated by patchwork-type innovation and entrepreneurship courses, which have not been designed in accordance with the characteristics of medical specialty. Therefore, the optimization of the co-creation field of professional education and innovation and entrepreneurship depends on the systematic reconstruction of medical courses. Medical curriculum design, curriculum system, and courses with different levels should cover general medical education courses, combined with the deep knowledge architecture of medical specialty. Personalized creative practice courses should be introduced, and general type of innovation and entrepreneurship education courses should be provided for a wider range of students to establish their innovative awareness and spirit, and inspire innovative thinking and entrepreneurial motivation. In-depth education curriculum should be set up for qualified innovative and entrepreneurial talents according to the nature of each medical specialty. Personalized practical courses of innovation and entrepreneurship are tailored to senior students, combined with the operation of professional practice, to cultivate high-quality talents with real awareness of innovation and entrepreneurship, knowledge and skills [45]. In terms of curriculum development and implementation, first, teaching materials for innovation and entrepreneurship education with medical specialty characteristics should be actively developed or with innovative and entrepreneurial knowledge should be integrated into medical specialty course materials. Requirements and evaluation indicators for the integration of professional education with innovation and entrepreneurship should be added when the teaching materials are approved or revised again. Secondly, it is necessary to develop innovative and entrepreneurial online education resources integrating medical professional knowledge, break the time and space boundaries of learning, and broaden the field of co-

creation. Third, medical education institutions should actively integrate the concept of innovation and entrepreneurship, innovate teaching methods, actively carry out project-based teaching in medical professional education, apply task-driven methods in stimulating medical students' active thinking and exploration spirit, and inspire medical students' innovative thinking.

5.2.3. From Contact Co-creation to Integration Co-creation

For a long time, medical professional education has played a leading role in all kinds of educational practices in medical colleges and universities. With the change of social situation and the strong promotion of the government, innovation and entrepreneurship education has been gradually incorporated into the talent training system of medical colleges and universities. Innovation and entrepreneurship education as well as professional education have generated a stirring spark. In the beginning, innovation and entrepreneurship are only activities based on products, technologies, services or business models, and the co-creation mode of the two is only point co-creation or intermittent co-creation, which shows a series of negative features such as low impact of medical professional education on innovation and entrepreneurship education, randomness, low efficiency and weak combination of professional medical education [27]. Therefore, professional education should be carried out on the basis of the expanding field of creation, the openness and inclusiveness should be enhanced, and mutual learning should be developed to produce new energy and complement each other. Resources in various fields, such as education, human resources, materials, etc., should be well organized, closely interconnected and integrated to prompt more efficient integration of design and education for evolution. Therefore, it is essential for medical colleges and universities to build innovation and entrepreneurship platforms such as service pioneer parks and mass innovation spaces. There are few successful operation cases on innovative entrepreneurship education with medical professional resources, thus for the medical colleges and universities, they need to integrate the production resources and establish the multi-functional innovation entrepreneurship education practice platforms for professional education. Enterprise resources on research and development should be introduced to the platforms where the innovative medical teaching spaces can be embedded. In addition, medical practice education should be conducted to promote the students' innovative practice ability [15].

5.2.4. Integration with First-class Disciplines and First-class Curriculum Construction

Innovation and entrepreneurship education should be integrated with high-level medical professional education. At present, China is in a tide of constructing "double first-class", which refers to first-class universities and first-class disciplines. The construction of first-class universities and high-quality disciplines cannot be separated from the construction of first-class courses. As the "Oscar" of higher education, China International "Internet +" Competition represents the highest level of education and teaching reform and the integration of industry and education. Therefore, medical colleges and universities should actively encourage the combination with professional features, taking China International "Internet +" competition as an opportunity to realize the medical professional characteristics and the integration of innovation based on the orientation of medical colleges and universities. Based on the context that affiliated hospitals of medical colleges and universities have long-term service experience in health and care in China, the innovation education can be deeply implemented and the symbiosis with first-class discipline construction and first-class specialty construction should be developed [20].

5.3. Innovating Medical Management Mechanism

5.3.1. Taking Innovation as the Guide to Develop the Characteristic Innovation of Medical Specialty

With the advantages of medical professional education, medical and health technology and services can be deeply cultivated. In China International "Internet +" Innovation and Entrepreneurship Competition, the uniqueness of medical colleges and universities is fully reflected in the whole process from specialty construction to the integration of entrepreneurship and innovation. In particular, the reform and innovation of primary-level medical and health technology and services should be deeply promoted, and undergraduate innovation and entrepreneurship education should be vigorously developed and innovated.

5.3.2. Reforming the Concept and Evaluation Mechanism of Courses Integrating Entrepreneurship and Innovation

Innovation and entrepreneurship education should be combined with the characteristics of medical students. The teaching concept of "distinctive awareness cultivation + knowledge popularization + practical experience" in medical courses should be highlighted, and the basic theory, knowledge and skills of innovation and entrepreneurship should be combined with innovation and entrepreneurship practice and medical related majors [32]. According to different professional groups, innovation and entrepreneurship courses and practice cases suitable for different medical students should be constantly developed from the perspective of complementing innovation and entrepreneurship knowledge and professional knowledge. Reform mechanism for education in innovation and entrepreneurship should be set up. Based on the education advantage in medical colleges and universities, a core concept of cultivating college students' innovation consciousness development and integrating entrepreneurship education and professional education should be established. Classroom teaching and autonomous learning are combined to assist students in learning with the guidance of practice and culture through the combination of theory and case teaching, thus the students can extensively discuss cases, and actively participate in class and practice, which can further enhance students' innovative spirit, entrepreneurial awareness and ability of innovation and entrepreneurship. Reforms should be carried out on the multiple assessment and evaluation mechanism to pay attention to students' ability to apply knowledge, and analyze and solve problems. Medical institutions should actively explore opportunities for the undergraduates to carry out innovative experiment, publish papers, apply for patents and convert their social practice results. Students can participate in activities such as research and project experiment as classroom learning, while the assessment result should no longer be determined by the final test paper at the end of each semester. There will be no standard answer to the examination content, highlighting the development of students' innovative and practical capabilities [18].

5.3.3. Structuring the Online and Offline Multi-channel Education Environment

Online education courses on innovation and entrepreneurship should be available. In the situation of the epidemic, students were suspended from school, and teachers and students worked together to fight against the epidemic. In case of this situation, medical colleges and universities should strengthen online interaction and offline communication, and combine online guidance with offline work to achieve effective education result. As the epidemic is alleviated, China International "Internet +" Innovation and Entrepreneurship Competition for College Students, "Journey for Youth Dream", an e-commerce livestream event, has invited entrepreneurs and outstanding alumni to give lectures on campus and give face-to-face guidance on entrepreneurship. Meanwhile, livestream activities can also be carried out to help farmers and to provide service for public welfare. Moreover, an online and offline innovation and entrepreneurship education mechanism should be established to promote the integration of college students' innovation and entrepreneurship practice with primary medical and health

services, thus the ideological and political education can be well integrated with innovation and entrepreneurship education.

6. Summary and Limitations

This study explores the innovation and entrepreneurship education reform of local medical colleges in the new context of medical education, analyzes the characteristics of medical education and provides reference for promoting the reform of medical education. However, the effectiveness of the reform still needs to be further tested in the process of practice, which is also the limitation of this study.

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References

- [1] KE H, LING W. Research on the development strategy of "New Medical Sciences" under the background of Healthy China [J]. Chinese Engineering Science, 2019, 21(02): 98-102.
- [2] JIAN L. New engineering construction: strongly build the upgraded version of "Excellence Plan" [J]. Higher Engineering Education Research 2017, (03): 7-14.
- [3] MINJIANG H, XIAOJUN D, GUANHAICHEN, et al. Research on university-enterprise collaborative training and practice of medical imaging talents under the background of "new Medical Science" [J]. Medical education research and practice, 2021, 29(04): 502-5+23.
- [4] YAFENG S, PAN H-S, SHIBIN W. The specialty layout and formation mechanism of "Double High Plan" construction universities [J]. Jiangsu higher education, 2021, (02): 112-8.
- [5] CAOYINGHUI. On exploring new ways to cultivate students' entrepreneurial spirit in higher Vocational colleges [J]. Journal of Liaoning Teachers college (Social Science Edition), 2018, (02): 74-7.
- [6] WANGZHANREN. The overall conception of innovation and entrepreneurship education in colleges and universities [J]. China Higher Education Research, 2015, (07): 75-8.
- [7] XIAOZHOU X, MIN Z. Concept reform and strategic choice of entrepreneurship education [J]. Educational Research, 2012, 33(05): 64-8.
- [8] ZHANGYAN. Concept discrimination and strategic Thinking of innovation and entrepreneurship education in Colleges and universities [J]. Chinese higher education, 2010, (23): 45-6.
- [9] CHEN X-C. Difficulties and mechanism innovation in the construction of teachers for entrepreneurship education in local colleges and universitie [J]. Higher Education of Engineering Research, 2017, (03): 170-3.
- [10] DEQIN J. Analysis on the construction of teaching staff for innovation and entrepreneurship education in Colleges and universities [J]. Chinese Higher Education, 2011, (10): 34-6.

- [11] ZHU X, MEIWEIHUI, CHAO Y. Difficulties and strategies in the faculty construction of entrepreneurship education in colleges and universities [J]. China Higher Education Research, 2012, (09): 82-5.
- [12] MA Y-B. The way to construct the curriculum ecosystem of innovation and entrepreneurship education -- Based on a case study of Tsinghua University's entrepreneurship education [J]. Higher Engineering Education Research, 2016, (05): 137-40+50.
- [13] GAO Z-G, YAN W, GANG W. On the teaching System construction of innovation and entrepreneurship education courses in colleges and universities [J]. Heilongjiang Higher Education research, 2016, (03): 93-5.
- [14] SHANGDAJUN. Construction of curriculum system of innovation and entrepreneurship education for college students [J]. Educational Research, 2015, (09): 86-90.
- [15] JINYAN H. Innovation and Entrepreneurship Education: Concept, System and Platform [J]. China Higher Education Research, 2018, (07): 7-11.
- [16] XIAOZHOU X, WEIHUI M, HAO N. College students' entrepreneurial dilemma and Institutional innovation [J]. China Higher Education Research, 2015, (01): 45-8+53.
- [17] XIAOZHOU X, LI Z-Y. System and Policy choice of Entrepreneurship education in Colleges and universities in China [J]. Research on Educational Development, 2010, 30(11): 12-8.
- [18] ZHU X-D, RONGRONG G, LIBAO W. Research on the integrated development of innovation and entrepreneurship education and professional education based on CDIO concept [J]. Jiangsu higher education, 2018, (02): 77-80.
- [19] JIAN L. The construction of new engineering specialty with multi-disciplinary integration [J]. Higher engineering education research, 2018, (01): 32-45.
- [20] WUYAN. First-class undergraduate, first-class major, first-class talents [J]. China University Teaching, 2017, (11): 4-12+7.
- [21] GANG Z, YANTING G. How do world-class universities build an entrepreneurial education ecosystem: Experience and Inspiration from Stanford University [J]. Comparative Education Study, 2014, 36(09): 25-31.
- [22] QIUJIANG Z, FA Z. "Trinity" : The construction and operation of entrepreneurship education model for college students -- experience from Ningbo University [J]. Chinese Higher Education research, 2009, (04): 84-5.
- [23] PEILIANG L, LIAN L. Discussion on the experience of Improving the employability of university students in UK [J]. Fudan Education Forum, 2009, 7(06): 72-5.
- [24] JIXUEJUN. Historical evolution and experience reference of Entrepreneurship education in American universities [J]. Heilongjiang Higher Education research, 2007, (02): 40-2.
- [25] ZHAOXIN H. Promoting the transformation and development of innovation and entrepreneurship education in Chinese [J]. Chinese Higher Education, 2017, (07): 45-7.
- [26] LIU G-X, CHANGSHI M. Explore the mechanism for integrating innovation and entrepreneurship education with professional education [J]. Education and Career, 2017, (20): 70-4.
- [27] HUI D, XIAOMEI Z. Deep integration of innovation and entrepreneurship education and professional education: Based on data analysis of universities in Beijing [J]. Chinese University Technology Transfer, 2017, (05): 91-4.
- [28] SONG K. A Study on the effects of Entrepreneurship Education on Entrepreneurial Opportunities and Entrepreneurship Intention [J]. Journal of Hotel & Resort, 2019, 18(2): 371-92.

- [29] ZHANREN W. Research on the disciplinary characteristics and development orientation of Innovation and entrepreneurship education in Chinese Universities [J]. Educational Research, 2016, 37(03): 56-63.
- [30] HARKEMA S J M, SCHOUT H J. Incorporating Student-Centred Learning in Innovation and Entrepreneurship Education [J]. European Journal of Education, 2008, 43: 513-26.
- [31] YAN L, WEI M, MENG A, et al. Exploration and practice of innovative practical education mode for college students [J]. Research and Exploration in Laboratory, 2016, 35(01): 166-8.
- [32] LIU B-C. Establish the concept of innovation and entrepreneurship education to cultivate innovative spirit and practical ability [J]. Chinese Higher Education, 2010, (12): 12-5.
- [33] SHIMING Z. Big data driving innovation and entrepreneurship education reform: Theory and Practice [J]. Tsinghua Journal of Education, 2016, 37(03): 65-73.
- [34] Opinions of The General Office of the State Council on deepening the Reform of Innovation and Entrepreneurship education in Institutions of Higher Learning [J]. Graduate Employment in China, 2015, (18): 4-5.
- [35] RADHARAMANAN R, JUANG J-N. Innovation and Entrepreneurship Education in Engineering [M]//JUANG J, CHEN C Y, YANG C F. Proceedings of the 2nd International Conference on Intelligent Technologies and Engineering Systems. 2014: 1281-90.
- [36] SUN B, IEEE. Reform of the Innovation and Entrepreneurship Education System in Colleges and Universities under the Application of Internet of Things Technology [M]. Los Alamitos: Ieee Computer Soc, 2021.
- [37] WANG J, LIANG Y, WANG J. Innovation and Entrepreneurship Education Ways of Agricultural Mechanization Majors [M]//MCANALLY E, HYLIND M, VOLODINA T, et al. Proceedings of the 2016 International Conference on Arts, Design and Contemporary Education. 2016: 1375-7.
- [38] JI C. ECOLOGICAL ENVIRONMENT OF INNOVATION AND ENTREPRENEURSHIP EDUCATION IN COLLEGES AND UNIVERSITIES [J]. Journal of Environmental Protection and Ecology, 2020, 21(5): 1906-14.
- [39] BAOSHUI MEI, YANGDONG. The basic characteristics of innovation and entrepreneurship education development in American universities and its enlightenment: A case study of MIT, Stanford University and Parkson School of Business [J]. Exploration of higher education, 2016, (11): 62-70.
- [40] CHAI X-D. A Comparison of entrepreneurship education in Universities of China, The United States and India [J]. University education management, 2009, 3(01): 85-92.
- [41] YINGYIYE. Research on entrepreneurship education in American Universities [D]; East China Normal University 2008.
- [42] LI L Y. Research on entrepreneurship education in American Universities [D]; Capital Normal University, 2008.
- [43] YANGHAN. Situational learning theory and its enlightenment to teaching reform [D]; Central China Normal University, 2012.
- [44] HUIZI H. Study on incentive Mechanism of College Students' innovation and entrepreneurship [D]; Anhui university, 2014.
- [45] ZHANGGE. Research on innovation and entrepreneurship education and Curriculum in universities [D]; Xidian University, 2012.