

Training System of College Students' Competence of Innovation and Entrepreneurship Based on Studio

JingWei Xie

Dalian University Innovation and Entrepreneurship, LiaoNing DaLian 116622, China
Email: 21115098@qq.com

ABSTRACT: In terms of cultivating college students' competence of innovation and entrepreneurship, the curriculum system of "three level and four platforms" and practice system have been formed in Dalian University, where the undergraduate innovation studio is regarded as an important practice platform. In recent years, it has formed a certain scale and achieved good management operation mode. A large number of outstanding students have been trained, which witnessed its fruitful innovative practical results. It has been proved in many years' practice that the innovative entrepreneurial competence training platform based on the undergraduate studio has played a powerful supporting role for college students to carry out innovation, entrepreneurial training and practical competence training, and has achieved excellent achievements in terms of the number of beneficiaries, the number of students winning awards, the competition of national undergraduate projects of innovation and entrepreneurship and the students' engineering training competence.

Keywords: *Innovative Entrepreneurship; Platform Establishment; Undergraduate Studio*

1. INTRODUCTION

As a local teaching and research university, Dalian University has determined the training objectives of "cultivating high-quality applied talents who can be human and capable, learn and innovate" needed in the first line of local economic and social development.[1-3] In order to achieve this goal, the school makes great efforts to explore the effective ways to cultivate the innovative competence of college students. As the result, it integrates and excavates the resources of innovative education effectively, and constructs the carrier of innovative and practical education represented by the undergraduate studio. Under the guidance of the strengthened institution and policy, various forms of educational activities have been carried out in Dalian university. What's more, remarkable remarks have been achieved, and a group of high-quality applied talents have been cultivated as well.

It is a new teaching model for students to develop innovative practice. The undergraduate studio is by means of the research theme. The research, the development, the production, the reform, the study, the practice has been carried on independently in the relatively free way according to the specific content, which is quite different from the scientific research room, laboratory and teaching and research office, it's pretty suitable for research and practice organization. The undergraduate studio is a group

of professional teachers and college students who have the common research direction and study interests. Their technology development, product design and production, student research and other related work of innovative entrepreneurship education are carried out in the fixed experimental places. The undergraduate innovation studio platform is the most important basic platform in the four platforms and the most essential practical carrier in the innovation and entrepreneurship education system in the university, as shown in Figure 1.

2. THE EVOLUTION OF UNDERGRADUATE STUDIO

Since the establishment of the first studio, Dalian University has conducted an annual year-end assessment and adjustment of the studio at the same time. Those unqualified studio would be canceled and replaced by the sound newly registered studio from the new applications. The studio has gone through 20 years of development. There were several major changes, which are as shown in figure 1:

In the "Hundred-Thousand-Ten Thousand" project implemented by schools in 2006:

"Hundred": 100 undergraduate innovation studios had been built.

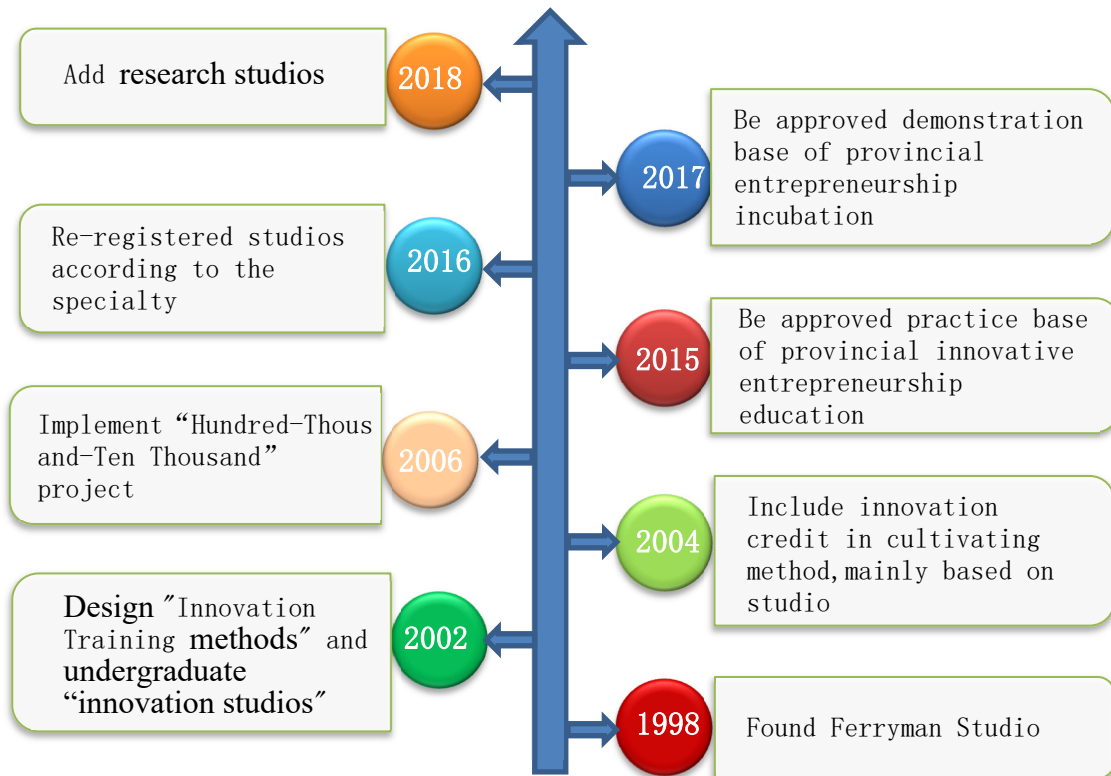


Figure 1 Several major changes

“Thousand”: 1,000 understudied projects have been implemented each year. (The early name is the undergraduate innovation education fund project by Dalian University, now it has a national name, that is the undergraduate innovation entrepreneurship training program project)

“Ten Thousand”: 10,000 undergraduate participate in various types of extracurricular activities in every year.

The university has determined its school-running characteristics as “Constructing an innovation and practical education carrier represented by studio and cultivating high-quality applied talents who can be human and capable, learn and innovate”.

The undergraduate innovation studio is integrated and upgraded according to the subject, specialty or industry in 2016. It had been re-registered as 57 professional studios, 51 professional comprehensive studios and 23 other types of studios, which are summed up to 131 studios. All the 56 undergraduate majors in our school are fully covered for the first time, and there is a professional studio in each major.

The studio model of the original independent room in the buildings of the Institute of Innovation and Entrepreneurship had transformed by the university in 2017, and the studio’s rights [4] of arrogating one single room had been canceled. All the rooms were taken back, which is to refuse to assign rooms separately for a particular studio. The functions and equipment in all the rooms are remoulded to all opened and shared room

layout.

In order to consolidate the important role of undergraduate innovation studio in the talent training system, improve its management and operation mechanism, optimize its way of setting up, and strengthen the function of combining science and education, and function of cooperating and educating people, scientific research platform[5] at all levels have been taken full advantage of, and the preponderance of the close combination of the improvement of teachers’ scientific research and technology development competence and the cultivation of outstanding talents. On the basis of the existing system, the undergraduate innovation studio puts their emphasis on the function of service discipline development and professional construction, and further strengthens the close combination with the scientific research platform at all levels of the university, the school enterprise alliance, the scientific and technological innovation team, the practice base and so on, whose aim is to activate the enthusiasm of teachers and students to innovate and start a business to the full. A certain number of leading scientific research studios have been set up, especially the related directions of the strategic emerging industries and urgently needed application research[6] of pillar industries in Liaoning and Dalian. There were 13 additional research studios in 2018.

3. CONSTRUCTION OF UNDERGRADUATE INNOVATION STUDIO

The investments of the university has increased greatly in recent years. More than 130 undergraduate studios have been built, which cover all the specialties, whose participants include nearly 300 teachers and over 4000 students every year. There are two parts in the existing studio: school concentration and college dispersion, which are managed by the institution of innovation and entrepreneurship. The studio of college dispersion is based on the laboratory of the college and its leading force is mainly the professional guide teachers. Those studios centered in the university are mainly located in the Institute of Innovation and Entrepreneurship, whose area is 2000 m², and they cover many majors such as machinery, electronics, mathematics, social sciences, art and other major categories. There is a maker space on the second floor, whose area is more than 100 square meters. It can sit 60 to 80 people for the studio meetings, discussions, training and other use. There are 8 large rooms on the third floor, they are intelligent control workshop, modern manufacturing workshop, 3D manufacturing workshop, mechanical and electrical creative workshop, electronic creative workshop, Hongshengtang dream workshop, internet innovation workshop and automation innovation workshop. The area of each workshop is 120 m², which can sit 80 to 100 people for innovative research and design and manufacturing work. There are 8 large rooms on the fourth floor, which are business incubator space, cultural incubator space, digital model space, art innovation space, multi-function hall and so on. The area of each room is about 140m², which is used to mainly to provide business incubator space for undergraduates. All rooms above are fully open to all members of the undergraduate studio. There are 3 staff in the Innovation and Entrepreneurship Institution, who are responsible for schedule management and maintenance.

3.1 Organizational Leadership

Establishment of the "Undergraduate Innovation Studio" leading group. The leading group is composed of the related personnel from the institute of innovation and entrepreneurship, the department of development planning and discipline construction, the department of science and technology, the department of education and so on, who are responsible for coordinating and guiding the development of all kinds of business activities; The institute of innovation and entrepreneurship is responsible for guiding, organizing and implementing innovation and entrepreneurship. With the help of these practice base of undergraduate innovative entrepreneurship education at the provincial level, the undergraduate studio, the national undergraduate projects of innovation and entrepreneurship, the subject competition and the entrepreneurial practice activities have been successfully carried out. What's more,

the undergraduate innovative entrepreneurial practice competence has been cultivated a lot.

3.2 Policy Support

Colleges and universities should be encouraged to give appropriate support in the aspects of scientific research base security, scientific research funding support and scientific research team formation. Undergraduates should be supported to undertake scientific and technological tasks at all levels. The information platform of innovation and entrepreneurship work is established, which is organized and collected by the institute of innovation and entrepreneurship, and the project needs should be regularly released to attract outstanding student teams to participate in the project.

3.3 Funding Support

A special funds is invested by the university each year for the operation and construction of the studio. Each studio obtains certain fund support from the school, which is divided into the basic fund and the special fund. Basic funds is 400 yuan per year for each studio, which is mainly used for the purchase of printing paper, ink cartridges, components and other basic consumables. Special funds are according to the special fund applications submitted by each studio on the basis of the next year's work plan. The leading group of the innovation and entrepreneurship institute studio is responsible for checking and examining the use of funds in the application for special funds, the achievements of the past years, the results of the annual appraisal of the studio, and also responsible for approving the amount of special funds. There are about 5 to 100,000 yuan per year in the university, which is used to support the studio to carry out special research and other work.

3.4 Annual Assessment

The innovation and entrepreneurship plan is brought into the medium and long term development plan of the school and the overall plan of the construction of the first-class local university by the school. What's more, combined with the requirements for innovation and entrepreneurship raised by higher authorities, the performance appraisal measures has been taken to examine the work situation of the studio, so as to form dynamic appraisal and elimination mechanism. The assessment of scientific research studio and other types of studios is organized by the institute of innovation and entrepreneurship.

According to the subject orientation and professional development, the institution formulates suitable and feasible evaluation standards and the examination methods for the college studios, and submits the detailed examination design to the innovation and entrepreneurship institution for the record. The examination scheme should

promote the improvement of the operating mechanism of the studio, fully show the working direction and working content, and devotes itself to advance the reform and implementation of innovative entrepreneurship education. The school has suggested that the examination proposal should include the number of students in the studio, the number of papers published publicly, the number of patent applications, the level and number of competition awards, the level and number of national undergraduate projects of innovation and entrepreneurship, and all kinds of entrepreneurial activities.

The workload of the studio guide teachers is distributed according to the standard of maximum 40 hours per studio per year (the college can refer to the year-end assessment order to decrease progressively the conversion), in principle, the workload is only distributed to the studio responsible teachers. The total workload of the excellent studio in last year is increased by 10 hours.

In the year-end assessment, each studio should submit the work summary form of the previous year and the work schedule of the next year, and each studio should make the cultivating plan of the studio at the same time.

4. STUDIO OPERATION MANAGEMENT

4.1 Space Management

More than 100 undergraduate studios have their fixed activity place in the university. Not only in order to achieve the concentration and utilization of resources, but also serve more student studio members, the studio in the building of the institute of innovation and entrepreneurship is set up as a fully open working mode [7-9]. For the sake of making better use of the limited physical space and equipment more efficiently, we continue to explore and improve the space management. At present, we adopt the information management in the university.

For better management and utilization of the hardware resources, the intelligent laboratory management system [10] has introduced into the open studio in the building of the institution of innovation and entrepreneurship to realize the automatic management of unattended duty. The laboratory management system makes the studio management more standardized and informalization, which not only improves the utilization rate of students' open research and design, and but also promotes the management level and service level of the school open studio. There are many modules in the intelligent laboratory management system, the specific application of our school is referred as the followings:

Reservation of students. At the beginning of each school year, the basic information of all studio members (number, name, major, class, college, all-purpose ID, affiliated studio, guide teacher, student level, etc.) is entered into the laboratory management system at one time. Students need to make a reservation for the right to use the laboratory (including room number, seat number, etc.) through the

online reservation system. School administrators conduct audits two times a day, at fixed time respectively in the morning and afternoon. Those approved students can use authorized student all-purpose card to come into the studio by themselves, and carry out their own research and design or other work content in specific seats. When entering the access control system, students will come into the laboratory management system video surveillance range at the same time. Two cameras are installed diagonally in each laboratory room to achieve no dead angle video recording of 24 hours a day. The maximum continuous time for each reservation is not more than 6 hours. If students are authorized, they should follow close to the line of studio management regulations, conduct scientific research in a safe and orderly way and pay attention to the cleanliness of the room and the specification for the use of articles.

The workshop on the third floor is divided into 3 levels according to the equipment in the room. The highest level is the modern manufacturing workshop, where there are over 20 lathes, such as WEDM lathe, ordinary lathe, ordinary drilling machine, milling machine, engraving machine, welding machine and other large lathes. On the one hand, these lathes must be operated strictly in the light of the safety regulations, on the other hand, these lathes also belong to precision machining instruments, which means high maintenance and maintenance costs. Therefore, the workshop only be available to use for those student member with rich experience (usually above third-year undergraduate or under the leadership of the senior has carried out practical operations on these equipment for many times. The middle level rooms are three-dimensional manufacturing workshop, intelligent control workshop and automation innovation workshop. In general, there are no compromises on the safety of these equipment in these three workshops, but these equipment are end to be more precise or valuable, like 3D printer, 3D scanner, oscilloscope, signal source, digital power supply, digital multimeter, multi-function test box, UAV, alpha robot, robot intelligent sorting system, intelligent 3D engraving system, etc. These instruments and equipment also need to be trained by studio elders before the reservation of students. The remaining workshops belong to the lowest level, where ordinary equipment can be used only after one or two simple training, so all studio members can apply at any time. There is no level in the maker space and incubation space on the second and fourth floor, because there is no precision and valuable equipment. Hence, all students are allowed to make a reservation so regardless of level.

The room that is available to students is determined by their level. The new studio member level is 1. After taking part in the training course of the use of the equipment in the system, their corresponding level will be upgraded. Of course, if students have participated in some science and technology competitions or national undergraduate projects of innovation and entrepreneurship major, their level also will be promoted accordingly.

4.2 Management by Project

The time limit of above student reservation is within 6 hours of every single use. If a competition is approaching, such as the National College students Intelligent Automobile Competition, the National College students Electronic Design Competition, etc., whose provincial competitions usually held during the holiday, and the students often need to make a continuous reservation of the studio from the end of their final examination to the opening of the competition. At this time, the reservation management by project is more convenient and practical, whose process is that, firstly, the students make a reservation in the laboratory management system, they also need to print out the reservation application form, and sign the commitment in the application form, at last, they should send it to the office of the institute of innovation and entrepreneurship. After examined by the management staff, they can be allowed to use the workshop and equipment for a long continuous time.

4.3 Credit Management

A lot of members have undertaken or participated in the undergraduate innovative entrepreneurship training project of at all levels, and many undergraduate innovative entrepreneurship competitions since they joined the studio. Not only in order to record the achievements of different student members, but also for the sake of the convenient management of open studio, the innovation credit management system is applied to record students' innovative activities and achievements by the university. All extracurricular academic activities of college students since they entered the school will be record in the innovative credit management system in detail. The management department can be able to know the extracurricular activities and the results obtained by undergraduates in time, and it is also easy and convenient for the studio management department to assess the students' level, which is cooperate with the previous laboratory reservation. Before their graduation, the educational administration of the university will print out the undergraduates innovative entrepreneurship credits as the second report card for the employer unit or other assessment. This report card is regarded as a comprehensive evaluation of students' innovative and entrepreneurial competence during college time, which has great practical significance in the present era.

A highly intelligent combination of hardware and software is applied in the open reservation innovative entrepreneurial laboratory management system, which reduces the burden of managers, improves the practical ability of students, and increases the utilization rate[11] of open laboratories and equipment in schools.

5. OBVIOUS ADVANTAGE OF STUDENTS CULTIVATION BASED ON STUDIO

The innovation of applied undergraduate talents pays more attention to the "New Application". Through the original innovation, integration and re-innovation of the professional knowledge, the latest technology, the research method or the technology, the students can be able to transform the high and new technology into real productive forces. Therefore, the cultivation of students' innovative competence should begin with the independent technological innovation. The innovative education base on undergraduate studios has special team advantage, freedom advantage and guidance advantage in promoting technological innovation of students and cultivating their innovative competence.

Team Advantages. Because of the common interests of the special research direction and theme, the members of the studio are free to form groups by two-way choice. The teams of learning, research and practice among teachers and students are formed around the research theme. The research atmosphere and research content in the team play a good leading role in students' participation of the related work of innovation, which can also stimulate students' enthusiasm to participate in and realize innovation. Students are free to communicate with the team at any time, so they can gain some experience and advice at any time, which can help them to improve their ideas and optimize their plans constantly. What's more, the students have the opportunity to communicate flexibly and deeply with teachers and students of different majors, which is helpful for them to have an intellectual collisions, to open up innovative ideas and horizons, to explore innovative methods and inspirations. In this way, It will be more easy to produce inventions, patents and other achievements for students.

Freedom Advantage. Free research method is highly praised in the studio. Students have a high degree of freedom in choosing research themes and time arrangement, so that their needs of innovation and their own potential can be fully satisfied. More importantly, the original ideas, works of students are fully respected, encouraged and supported, so that students can keep working until they achieve their goals.

Guidance advantage. These guide teachers of professional studio are full-time teachers of the major, who have relevant professional skills, and a certain engineering practice ability[12]. Guided by the teacher, students can be able to engage in innovative entrepreneurship related research and practical work in a more professional way. These guide teachers of the scientific research studio are the scientific research personnel of the scientific research platform or laboratory, which is above the provincial level. These teachers can provide the students with the guidance experience that is closer to the project. The guide teachers of studio have the obligation to guide and cultivate students. Under the guidance of the teacher, the students know how to study the research topic in a systematical way, so that students can understand the present situation of a

certain specialized technology, and come up with some practical ideas and designs for technological innovation on this basis.

Practical advantages. The studio is just like a processing plant, which has the conditions of independent design, transformation and production. Students can have a chance to obtain the guidance and help from the team in time, so that it become easy for them to accumulate more practical experience. The concept of “learning by doing”, “thinking by doing”, “changing by doing” and “innovating by doing” can be really realized, which can be helpful to form the actual achievements of technological innovation.

The studio has undergone many reforms for the past two decades, which has formed the advantage of “free form of practice, co-existence of cooperation and competition, effective special training”. It has played an irreplaceable role in innovative entrepreneurship education.

6. SIGNIFICANT ACHIEVEMENTS OF INNOVATION AND ENTREPRENEURSHIP

At present, the studios have been integrated and upgraded according to disciplines, specialties, scientific research platforms or industrial fields, whose number has up to 135. Their annual average undertaking of undergraduate practices projects is 75%. Besides, 85% of the undergraduate competition awards come from the studio. In recent years, the studio undergraduates have obtained 163 projects of the national college students’ innovative entrepreneurship training programs, and 380 projects of provincial college students’ innovative entrepreneurship training programs. The students published more than 350 research paper as the first author, including 130 core journals, nearly 30 retrieval papers, more than 110 patents. What’s more, there are more than 30 entrepreneurial firms, whose legal persons are the studio students. The highest awards in major scientific and technological events, such as the national college students electronic design competition, the national college students mathematical modeling competition, the national college students intelligent automobile competition, the national college students energy saving and emission reduction social practice and science and technology competition, and the national youth entrepreneurship plan competition, all come from undergraduate studio members.

In 2006, the school running characteristics summarized by the studio in the evaluation of the undergraduate teaching work level of the Ministry of Education were highly affirmed and evaluated by the expert group, whose evaluation results were excellent.

In the top lists of “Evaluation Results (Undergraduate) TOP300 of National College Competition from 2014 to 2018” released by the expert working group on the Evaluation and Management System of University Competition of China Higher Education Institute, the total scores of our school ranked No.4 in Dalian city, No.8 in Liaoning province and No.207 in China.

In 2018, the school was audited and evaluated by the

undergraduate teaching work department of the Ministry of Education. In the feedback evaluation, the group leader said that “There are significant achievement in innovation and entrepreneurship education” In order to actively build connection with the society, the curriculum system of “three level and four platforms” and practice system has been formed in the school to promote the conjunction between curriculum and practice, integrate the inside and outside of the school, obtain both competence and achievement, meet the inclusive requirements and personalized needs at the same time. The promotion in the combination of innovative entrepreneurship education and professional education has greatly promoted students’ innovative entrepreneurial competence.”

7. Conclusion

The innovative entrepreneurial practice activities based on the undergraduate innovation studio is a traditional and characteristic second classroom project of Dalian University, which has achieved remarkable results over the years. Therefore, Dalian University has been approved as one of the first batch of provincial demonstration universities of deepening the reform of innovative entrepreneurship education, the demonstration base of provincial undergraduate entrepreneurship incubation, the practice base of provincial undergraduate innovative entrepreneurship education and the provincial and municipal maker space.

In order to implement the opinions of the central committee and the provinces and cities on the deepening of the reform of innovation and entrepreneurship education in colleges and universities, the school has formulated “*The Work Plan of Deepen the Reform of Innovative Entrepreneurship Education in Dalian University (2017-2020)*” and “*The Construction Planning of Undergraduate Innovative Entrepreneurship Incubator Base in Dalian University*”, so as to steadily advance the scientization, institutionalization and standardization of the innovative entrepreneurship education construction. The sufficient special funds are invested to support the work of innovative entrepreneurship education every year, which gradually improves the operation and management of undergraduate innovative studio, and strengthens the cultivation of students’ entrepreneurial consciousness, innovative spirit and entrepreneurial competence. The practical mode of innovation and entrepreneurship promoted by the undergraduate innovation studio and the connotation construction of “three levels and four platforms” innovation and entrepreneurship education system have been enriched year by year.

REFERENCES

- [1] Yuguang Li, Xieyong Wang. Dalian University's "Three Levels, Four Platforms" Innovative Entrepreneurship Education Model, China University

Science and Technology, 2017 (Z1): 102-104. DOI: <https://doi:10.16209/j.cnki.cust.2017.z1.032>.

[2] Hui Guo,Ziming Shi,Yubin Pang.The Exploration and Practice of the "One, Two, Three, Four" Innovative Entrepreneurship Education Model in Local Colleges and Universities, *Journal of Dalian University*, 2018, 39 (05): 122-128.

[3] Zhiqiang Wang.Cultural Logic of Cultural Heritage Innovation and the Scientific Development of Local Colleges and Universities, *Journal of Cultural Studies*, 2011 (06): 5-10.

[4] Lili Huang,Junfeng Tang,Haisheng Zhang.Under the background of innovation and entrepreneurship education, Songjiang University City Laboratory Resource Sharing Model Explores experimental technology and management, 2018, 35 (11): 245-248. DOI: <https://doi:10.16791/j.cnki.sjg.2018.11.057>.

[5] Liping Yin.The president of the United States, Mr. Yu. Construction of Practical Innovation Platform and Exploration to Improve Student Engineering Practice Capabilities. *Experimental Technology and Management*, 2018, 35 (07): 34-37. DOI: <https://doi:10.16791/j.cnki.sjg.2018.07.009>.

[6] Xingxing Li.Reform and Practice of the Management Mechanism of The Professional Laboratory of Information In universities, 2018, 37 (10): 277-279 and 289.

[7] Hao Zhu,Brian Peringer,Zhihong Zuo,Kai Yan.Open Computer Lab Service Model Research . *Laboratory Research and Exploration*, 2018, 37 (11): 259-263.

[8] Aihua Wang,Yan Yu,Guoliang Huo. Exploration and Innovation of the Teaching Model of Fully Open Engineering Training, *Laboratory Research and Exploration*, 2018, 37 (10): 171-175.

[9] Minhui Li,Qiang Zou,Tai Yang.Practice and Exploration of Standardized Management of The Open Comprehensive Experimental Platform, *Experimental Technology and Management*, 2019, 36 (01): 259-261 plus 282. DOI: <https://doi:10.16791/j.cnki.sjg.2019.01.060>.

[10] Juan Lou,Jun Zou,Shuguang Li.The construction model of the innovation base of electrical information practice for college students explores the research and exploration of the laboratory, 2018, 37 (11): 233-237.

[11] Tao Han,Wei Yao,Lingxia Lu.The construction of an exploratory experimental platform oriented towards

the cultivation of innovative talents, experimental technology and management, 2018, 35 (07): 19-22. DOI: <https://doi:10.16791/j.cnki.sjg.2018.07.005>.

[12] Tao Guo.The engineering practice of colleges and universities is consistent with the design and exploration of the standard-to-standard guarantee system, 2018, 37 (12): 249-251+265.