

Mechanical Engineering Innovation and Entrepreneurship Education Practice and Innovation Effectiveness Analysis

Xinhua Wang, Tianjian Li*

School of mechanical engineering, University of Shanghai for Science and Technology, Shanghai 200093, China

*Corresponding author: Litianjian99@163.com

Keywords: Practical exploration, Professional characteristics, Case study, Innovation and entrepreneurship, Results analysis

Abstract: Innovation and entrepreneurship education is a hot spot in my country's higher education field in recent years. Based on the characteristic practical experience and typical cases of the 5-year professional innovation and entrepreneurship education in mechanical engineering at the University of Shanghai for Science and Technology from 2015 to 2019, this article clarifies the specific implementation procedures of innovation and entrepreneurship practices based on professional knowledge in mechanical engineering and analyzes the implementation effects. In practice, each mechanical engineering innovation team can independently complete the innovative product design and communicate with the manufacturer during the entire manufacturing process to complete the process design, patent application protection for the results, and obtain the core required for innovation and entrepreneurship Ability to achieve the goal of the school's innovation ability training. At the same time, innovation starts from meeting the most basic school and family needs, and gradually shifts to meeting social needs and paying attention to people's livelihood. Students' vision, awareness of innovation, innovation ability, innovative feelings and family spirit are also improving year by year. The innovative and entrepreneurial education practice with the characteristics of mechanical engineering has achieved good results.

1. Introduction

University innovation and entrepreneurship education is an important way to cultivate students' sense of innovation and subjective initiative, adapt to the development trend of globalization, and promote economic development [1]. In May 2016, the General Office of the State Council issued the "Implementation Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Colleges and Universities", comprehensively proposing specific measures to improve the innovation and entrepreneurship education system in my country's universities.

At present, innovation and entrepreneurship education has gradually been raised to an important strategic level for the comprehensive construction of my country's innovation and development. The dual innovation education curriculum of domestic universities has changed from system

construction [2-3] to curriculum arrangement [4], teaching methods [5] and practical models [6-7] and other aspects are facing major challenges. The construction of the system of innovation and entrepreneurship courses should ensure that from simple knowledge transfer to training students to be good at thinking and exploring the spirit of innovation, good at cooperating and understanding the moral quality of gratitude, and the persistent attitude of not giving up in the face of difficulties and setbacks, and creating value, The sense of responsibility to return to society and the ideals and ambitions of serving the country and the people are transformed [8]. Double innovation education should meet the basic literacy of innovation and entrepreneurship [9] and the training needs of awareness, professional knowledge of innovation and entrepreneurship, professional ability and skills of innovation and entrepreneurship, and carry out the whole process management [10], so that all students can acquire the basic ability of innovation and entrepreneurship.

Since the guiding ideology of innovation and entrepreneurship education is to stimulate students' initiative and enthusiasm to participate in the innovation and entrepreneurship training program, cultivate students' sense of innovation, and improve students' innovative ability. The implementation of innovation and entrepreneurship education should adhere to the combination of professional background, use practice to drive the development of the innovation system and continue to summarize and continuously improve the dynamic process of improving students' professional quality.

In the School of Mechanical Engineering of University of Shanghai for Science and Technology, the implementation of innovation and entrepreneurship education is precisely the dynamic process of driving system development with practice and continuous summary and continuous improvement [11-13]. This article starts from the implementation process of the mechanical engineering specialty of innovation and entrepreneurship education, introduces the specific implementation procedures and implementation cases of innovation and entrepreneurship practice in detail, and tests the effectiveness of innovation and entrepreneurship education implementation with cases and practices.

2. Innovation and entrepreneurship education professional features implementation process

As a new policy, innovation and entrepreneurship education needs to carry out effective management of innovation and entrepreneurship training plan in the implementation process, so as to ensure clear responsibility and guarantee in place and ensure orderly implementation of innovation and entrepreneurship training plan. Figure 1 shows the implementation process of innovation and entrepreneurship education for mechanical engineering major in school of mechanical engineering, University of Shanghai for Science and Technology. The innovation and entrepreneurship training program is managed at both the school and college levels. The academic affairs office of the university initiates the annual innovation and entrepreneurship education and training program, and sets up an expert review group to review the projects of the practical innovation and entrepreneurship training program. In figure 1, yellow marks some related work contents of academic affairs office at the university level. As a second-level college, the college of mechanical engineering is responsible for the publicity, organization for registration, guidance and management of college students' innovation and entrepreneurship training plan, as shown in the green part in FIG. 1. The main body of innovation is students, as shown in figure 1, which is a large red logo representing the independent innovation work of students.

Innovation training is the undergraduate team, under the guidance of the tutor, independently complete the innovative research project design, research conditions, preparation and project implementation, research report writing, achievements (academic) exchanges and other work process. Considering the characteristics of mechanical engineering, mechanical professional college

students' innovative entrepreneurial training programs focus on cultivating students' innovative academic ideas, purpose, meaning of professional design and invention, therefore, project establishment, teachers will guide students sufficient theoretical basis through feasibility research, innovative and exploratory project, complete the research plan is reasonable, feasible technique route, creative implementation conditions of the project plan.

The project plan will be submitted to the school's academic affairs office for review and approval after the preliminary review of the school's academic affairs. Due to the steadfast work in the early stage, the innovation plans of the mechanical major can basically pass the review and get the project approved. After that, the characteristic practice and exploration work of mechanical engineering innovation and entrepreneurship education major -- the specific implementation of innovation projects is marked by dots and lines in figure 1. As before the writing of the proposal, the feasibility study stage, mechanical functional structure design has already had a prototype. Therefore, the first step of the project implementation is to refine the mechanical structure and function design and develop processing technology CARDS. Since the products of the innovation project are produced in a single piece, the student union will cooperate with the processing plant to complete the processing and manufacturing process in the processing process with the technical support of the instructor. After the preparation of process card in the whole implementation, the college will conduct a mid-term inspection of the project, which mainly includes the functional structure, rationality of process card and cost control of processing and manufacturing. In this process, students have spent several months trying to create with their own professional knowledge, getting familiar with design, technology and manufacturing, and confidently confirming the correctness of each process, constantly improving their professional ability and innovation ability.

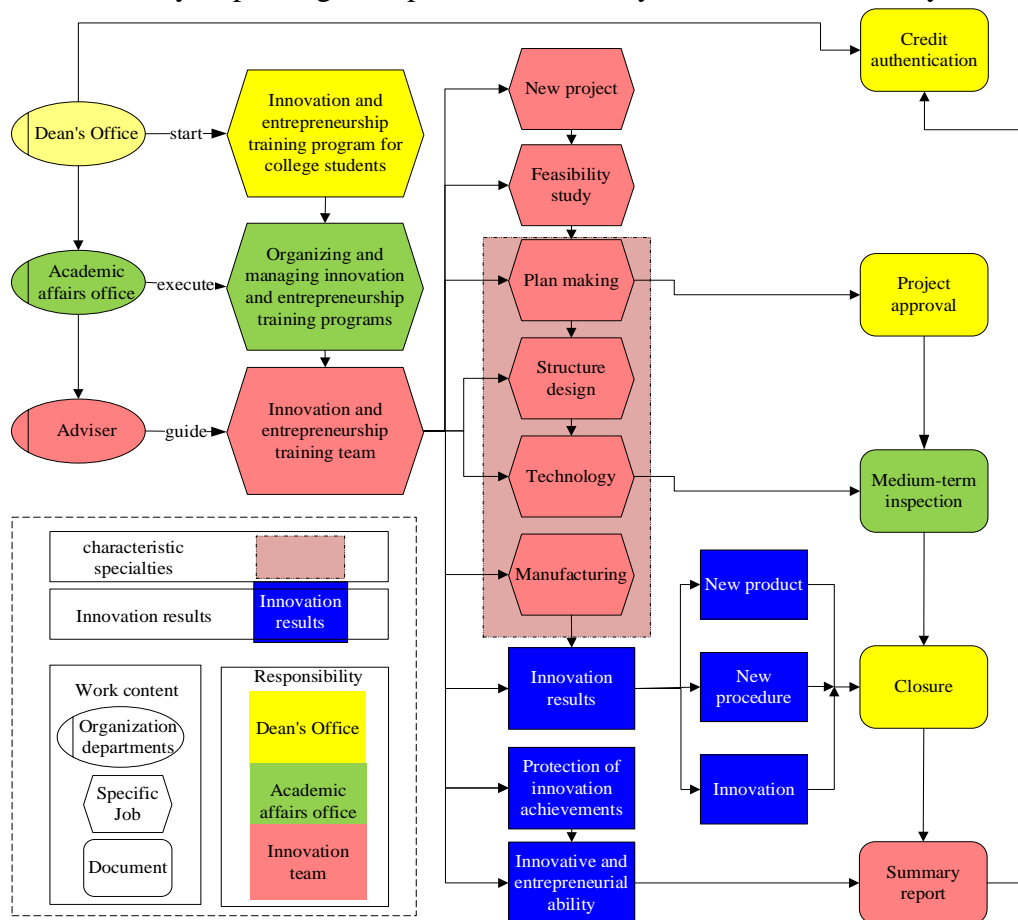
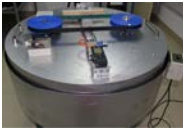
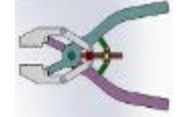

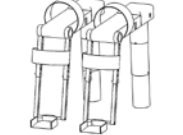
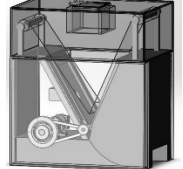





Figure. 1 Basic process of education practice

From concept innovation to prototype manufacturing, students obtain new products, new methods and new technologies, and obtain intellectual property certificates of professional products designed by themselves, as shown in the blue key mark in FIG. 1. This kind of innovative and entrepreneurial thinking and ability formed by self-improvement and experience should be the highest goal of cultivating students' innovative and entrepreneurial ability.

3. Innovative practice exploration

Table 1 series of practical exploration cases of machinery major in recent 5 years

Theme	Profile	Results
2015 Magic dream class	Coriolis accelerometer: the Coriolis inertial force is measured indirectly by equivalent substitution method, which reduces the difficulty of Coriolis inertial force measurement and verifies the Coriolis acceleration calculation formula.	
2016 Design and manufacture of household mechanical appliances or appliances	Booster wrench: through the multistage gear to speed up the effect of torsional increase, variable speed, time saving, suitable for multi - work.	
	Multi-purpose variable rickshaws: fast transformation of bicycles and tricycles, dual use of one vehicle, no deformation of the mechanical intervention, to achieve the reliability and safety of cycling and cargo function conversion.	
2017 Serving the society -- efficient, convenient and personalized	Portable seat for subway: it covers a small area, does not disturb others, is safe to use, and reduces the fatigue of seatless people. The overall function is realized by simple mechanical structure, and the reliability is good.	
2018 Creative life to serve the society	Rapid umbrella packaging system: the use of thermal sealing and automation technology automatic rapid packaging umbrella, effectively prevent rain falling on the indoor, keep the indoor clean.	
	Involute circular arc coin sorting and packaging machine: multi-purpose coin sorting equipment, integrating the functions of coin sorting, counting and stacking and packaging.	
2019 Pay attention to the livelihood of the people, and better homes	Pineapple picking artefact: programming to achieve capture, ranging, positioning, clamping, breaking, basket loading integration automatic picking, high efficiency.	
	Intelligent community parking lot: develop underground space, increase the number of parking and do not affect the residential space of the community.	

From 2015 to 2019, the practice series of mechanical major under the guidance of the college for the past five years has changed from the mode of cultivating outstanding talents to the mode of full participation, which meets the requirements of "popular innovation". There are two basic starting points for students' innovation practice exploration. One is that the annual theme of the national

mechanical innovation design competition for college students will be announced every year, and the professional innovation training will generally guide students to think and innovate under the guidance of the theme. The other category is for students choosing their own topics and apply for special funding support of school and municipal innovation projects. Table 1 shows that under the guidance of the annual theme of the national college student mechanical innovation design competition, some students won the innovative design awards. In the past five years, the winning rate of the college students' mechanical innovation design competition was more than 50% on average.

Under the guidance of these two ways of practice and exploration, in 2015, some students of the college participated in the national college student mechanical innovation design competition, and the proportion of students participating in innovation was 5%. In 2016, 20% of students participated in innovation. In 2017, since the innovation framework of the college (figure 1) has been established, students can participate in innovative activities through university-level projects, city-level projects and national projects to achieve innovative practice, and the proportion of students who participate in innovation has sharply increased to 50%. In 2018 and 2019, as the innovation of middle school students in the teaching system has been included in compulsory credits, the participation of students in innovation practice has reached 100%.

4. Analysis of effects

The progress of the participation rate of students from 5% to 100% is actually the progress of innovation and entrepreneurship consciousness of students under the guidance of the state. In recent five years, students' understanding of innovation and level of innovation ability are improving. This leap and change are shown in figure 2.

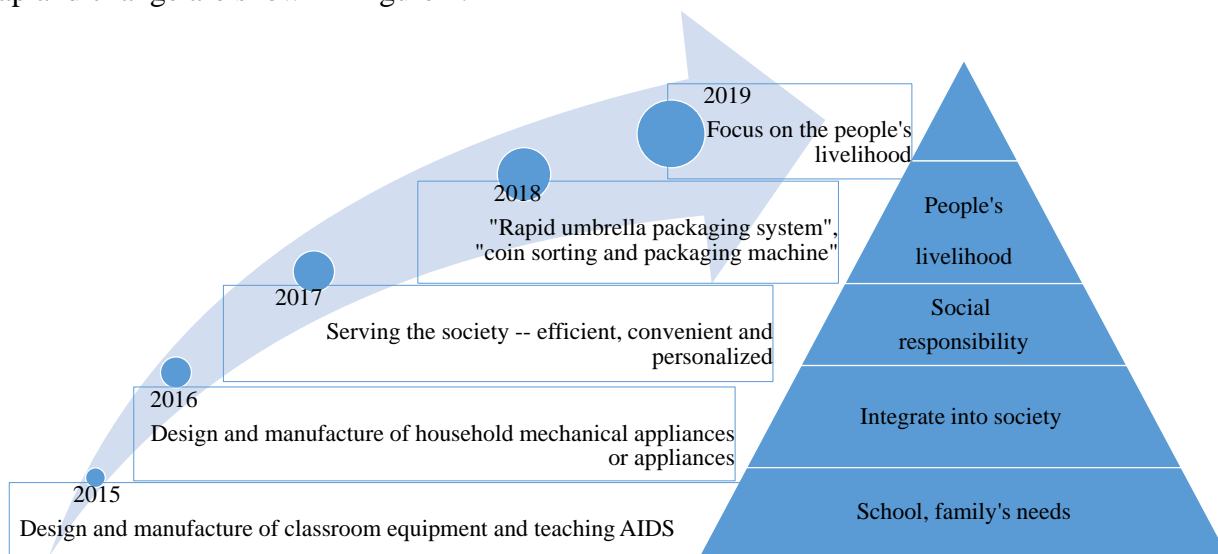


Figure. 2 Results of exploration

Before 2016, the title of the national annual innovation competition was to use professional basis to meet the needs of simple schools and families. At that time, the theme of the competition was "design and production of classroom equipment and teaching AIDS" and "design and production of household mechanical appliances or appliances". This level of innovation, only in the professional skills to meet the immediate can see the simple needs. Since 2017, innovation has stepped out of the "campus" and "family" and started to step out of the "pyramid" and integrate into society. Student

innovation has significantly improved the quality of exploration. A typical representative work is "portable seat for subway". By 2018, the theme of innovation is "serving the society" based on "creative life". In 2018, students' works "rapid umbrella packaging system" and "coin sorting and packaging machine" began to have a sense of social responsibility. Obviously, they were concerned about the country and the people, and began to have the ideal ambition of serving the country and the people reflected in their innovative works. In 2019, students began to look at themselves and start to have a far-sight. When they started to create, their works included "pineapple picking" and "intelligent community parking lot", and they obviously had a real innovator and national feeling of "looking up at the stars and down to earth", which paid equal attention to people's livelihood and a better home".

5. Conclusion

Through five years of practice and exploration of the characteristics of mechanical engineering major of innovation and entrepreneurship education, students have made significant progress in both professional skills and innovative thinking. The most important thing is that in the innovative practice and exploration, students are inspired to be good at thinking and have the courage to explore the innovative spirit. Students become good at cooperation, know how to be grateful, with the face of difficulties and setbacks do not speak out of turn give up persistent attitude, as well as create value, the sense of responsibility to repay the society and the ideal of serving the country and the people. This is exactly what the country expects from college students and what education expects from the future.

References

- [1] Zhang Z. *Constructing the practical teaching system of innovation and entrepreneurship education for engineering college students* [C] // *International Conference on Computer Science & Education. IEEE, 2015.*
- [2] Wei Y, Guo W. *Construction of the Entrepreneurship Education Teachers Based on the Characteristics of Business Education Level* [J]. *International Education Studies*, 2010, 3 (2).
- [3] Topalli D, Cagiltay N E. *Improving programming skills in engineering education through problem-based game projects with Scratch* [J]. *Computers & Education*, 2019:S0360131518300113.
- [4] Hu J. *Research on Creative Education, Integration of Industry and Education in the Application Talents Cultivation* [C] // *2016 International Conference on Management, Education, Information and Control. 2016.*
- [5] Marques C , Santos G , Salvo A , et al. *Entrepreneurship education, gender and family background as antecedents on the entrepreneurial orientation of university students* [J]. *International Journal of Innovation Science*, 2019: 00-00.
- [6] Beiler O, Michelle R. *Integrating Innovation and Entrepreneurship Principles into the Civil Engineering Curriculum* [J]. *Journal of Professional Issues in Engineering Education and Practice*, 2016, 141 (3): 04014014.
- [7] Liu X, Wang Q. *Discussion on New Measures for Universities to Promote and Deepen Innovation and Entrepreneurship Education Reform* [C] // *International Conference on Education, Management, Computer and Society. 2017.*
- [8] Yang L P, Xu D W, Wang W. *The Application of Intelligent Agent in Network Platform for Undergraduate's Innovation and Entrepreneurship Education* [J]. *Applied Mechanics & Materials*, 2015, 687-691: 2149-2152.
- [9] Mckelvey M, Zaring O. *Co-delivery of social innovations: exploring the university's role in academic engagement with society* [J]. *Industry and Innovation*, 2018: 1-18.
- [10] Hang G, Ping R A, Long Y, et al. *On the Cultivation of Innovative Ability of Higher Vocational Students* [J]. *Educational Research*, 2008.
- [11] Iii F J M. *The Entrepreneurial Engineer: Educating Tomorrow's Innovator (Special Issue)* [J]. *Social Science Electronic Publishing*, 2005.
- [12] Zhong H, Xu W, Hu H, et al. *A whole-process progressive training mode to foster optoelectronic students' innovative practical ability* [C] // *Society of Photo-optical Instrumentation Engineers. 2018.*
- [13] Li TJ, Ding XH. *Exploratory Practice for Innovation and Entrepreneurship Education in Mechanical Design Course Exercise* [J]. *Experimental Technology and Management*, 2017, 33 (04): 22-24. (In Chinese)
- [14] Wang XH. *Build an integrated laboratory based on advanced manufacturing system* [J]. *Machinery Design and Manufacture*, 2005 (10): 120-122. (In Chinese)

[15] Ding XH, Li HL, Qian W. cultivation mode of mechanical innovation talent based on outcome-oriented education [J]. *Research in Higher Education of Engineering*, 2018 (01): 119-122+144. (In Chinese)