

The joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents

Shuangyue Xiao, Yanping Wang, Li Liu*

Department of Information Science and Engineering, Dalian Polytechnic University, Dalian, China

**Corresponding author*

Abstract: Along with the high-speed development of information technology, more and more applied talents are required in the area of electronic engineering. Campus-enterprise joint training model provides an effective way to make progress of the reform in higher education. In this paper, the characteristics of electronic engineering are analysed based on the actual situation of university, and plans of the campus-enterprise co-laboratory are proposed from aspects of fundamental curriculum construction as well as laboratory construction. Besides, steps to build co-laboratory of the campus-enterprise cooperation are discussed to cultivate high-quality electronic engineering talents for the fast development of the society.

Keywords: *electronic engineering, campus-enterprise cooperation, co-laboratory*

1. Introduction

With the reform of the higher education management system, the common problem faced by universities is how to cultivate practical talents that are consistent with the requirements of social development. The higher education model is undergoing a profound change including the improvement of laboratory system as an important base to train students' practical and innovation ability in university [1]. Therefore, to establish a co-lab with industry can improve the level of education and cultivate high-quality talents.

At present, the joint training model of the campus-enterprise has become an internationally recognized standard model for applied talent training. In particular, electronic engineering laboratories have outstanding advantages in cultivating applied talents, such as quick results and close integration of production, education and research [2]. The question worthy of research and discussion is that application-oriented universities how to make full use of the resources of their laboratories according to their own characteristics. The purpose is that application-oriented universities do a good job in the construction of the campus-enterprise co-laboratory and the training of students. According to research and practice the joint training model of the campus-enterprise co-laboratory. On the one hand, the model makes full use of university laboratory resources to cultivate electronic engineering talents; On the other hand, it can also promote enterprises to create engineering practice centers, and provide a good platform for enterprise development and recruitment. Be advised that papers in a technically unsuitable form will be returned for retyping. After returned the manuscript must be appropriately modified.

2. The main problems of domestic campus-enterprise joint training

Campus-enterprise cooperation first emerged in Germany at the end of the 19th century. Campus-enterprise cooperation mainly includes the creation of internship bases, entrusted order training, and introduction of corporate funds. But most of them are only formal, and there are still the following problems from concept to implement [3]:

- 1) The government has not yet established a truly long-term, "win-win" system.

Although relevant government departments actively advocate campus-enterprise cooperation, they lack effective mechanisms, insufficient financial support, and lack of platforms for communication. Moreover, the contribution of enterprise in campus-enterprise cooperation lacks social recognition and

financial compensation [4]. And it is difficult for enterprise to bear the risks of students' internships. These problems make campus-enterprise cooperation without binding force and impetus. So, campuses and enterprises need to spend a lot of manpower and material resources in seeking appropriate partners. These conditions affect the in-depth and sustainable development of campus-enterprise joint training [5].

2) The cognition differences among universities, enterprises, and students, and the cooperation concept is not clear enough.

Currently, universities, enterprises, and students have not reached a good agreement on their respective perceptions, and they emphasize self-interest too much. Therefore, campus-enterprise joint training has become a situation where everyone takes their needs and their own affairs. Enterprises are mostly passive in campus-enterprise cooperation. Enterprises see campuses as a cheap labor market in pursuit of profit. Enterprises also invest and train students in order to win government projects. However, because students are not employees of the enterprise, they have a certain degree of retention on all investments made by students. Students don't get the exercise that they should have, and campus-enterprise cooperation tends to form [6].

3) The campus's talent training mechanism needs to be adjusted.

Since the end of the last century, a large number of junior universities in my country have been upgraded to undergraduate campus. Most of them imitated the experience of old universities and pursued "large and comprehensive". The talent training of these universities has no characteristics. In addition, some newly-built undergraduate universities have some problems, such as inaccurate target location for application-oriented undergraduate talent training, disciplinary and professional settings are not compatible with the needs of industries and enterprises for talents [7].

3. The construction model of the joint training of the campus-enterprise co-laboratory for electronic engineering talents

With the rapid development of science and technology, electronic engineering related technologies have wide applicability in various fields in our country. Due to the importance of electrical-related technologies, the society's demand for high-tech application-oriented talents in this type of specialty has increased. And society also requires them not only to have a high theoretical level, but also to have a high innovation and practical ability. According to in-depth research the new mechanism of campus-enterprise joint training of electrical engineering and technical talents in telecommunications, automation, it shows that campus-enterprise cooperation needs to jointly formulate training goals, jointly build curriculum systems and teaching content. Campus-enterprise cooperation also needs to jointly establish laboratories, jointly implement training procedures, and jointly evaluate training quality [8]. The specific research content is as follows.

3.1. The joint training model of the campus-enterprise co-laboratory

One training cycle of the campus-enterprise joint training model is 4 years for university students majoring in electronic engineering, including 4 corresponding stages: adaptation period, growth period, improvement period, and maturity period. First-year university students are in the adjustment period. The campus mainly teaches basic theory courses. Students will be trained in career planning, professional education, and student technological innovation activities. The campus-enterprise joint training model achieves phased goals, including establishing students' professionalism of seeking truth and being pragmatic, cultivating students' interest in learning subjects and majors, and mobilizing students' enthusiasm for participating in science and technology competitions; Second-year university students are in the growth stage. The campus mainly teaches applied theory courses. Students will apply for innovative topics and conduct social practice. The campus-enterprise joint training model achieves the stage goal of cultivating students' hands-on ability and social adaptability [9]; Third-year university students are in the raise phase. The campus focuses on training operational skills. Students will complete innovation projects, pre-job training, production training, student scientific and technological innovation activities and other practices. The campus-enterprise joint training model realizes the staged goal of students learning advanced and practical professional knowledge and skills. In addition, it trains students' adaptability to actual work and cultivates students' business hands-on ability; Fourth-year university students are in the maturity stage. The campus is mainly to help students integrate knowledge and skills. Students will complete career guidance, graduation internship and

graduation design. Students will receive comprehensive training. The campus-enterprise joint training model achieves stage goals, such as further strengthening students' practical ability, innovation ability and entrepreneurial ability. Furthermore, it improves the core competitiveness of students' employment [10].

3.2. Campus-enterprise joint construction of laboratory

In order to improve students' practical ability, students must apply the relevant theoretical knowledge and case analysis of electrical majors learned in the classroom to practical training. Therefore, it is very important to build a complete laboratory. The construction of the laboratory cannot be carried out blindly, and the following points should be considered comprehensively [11]:

(1) Analysis of social and market development needs. What types of talents are needed by companies in today's society and these talents must have what kind of abilities.

(2) The laboratory construction must be forward-looking. The laboratory is now not only cultivating talents for the needs of the Society nowadays, but should look to the next ten years or even longer. The purpose is that students can master the skills needed for future social development through laboratory training, and provide important prerequisites for students' employment after graduation [12].

(3) Seek truth from facts, step by step. Our campus is a local undergraduate university. Compared with key universities, our campus still has a big gap in all aspects. The construction of laboratories requires a lot of funds, but the central government's annual investment in supporting the construction of local universities is limited. Therefore, campuses need to unite with enterprises to build laboratories. This is very useful for the training of students in campuses and the demand for talents by enterprises.

(4) The simulation principle of the laboratory. The student laboratory should fully reflect the characteristics of the site and has training posts that are as consistent as possible with the actual production sites in the society. For example, according to the needs of the current society and the personal interests of students, the laboratory has different research groups.

(5) Sharing principle. The laboratory can not only provide a place for students to practice training, but also provide training for workers in social related industries. The purpose is to reach Resource Sharing. The construction of the laboratory requires the participation of teachers from the campus. And the laboratory must also involve enterprise technical personnel. The campus should often hire enterprise technical backbone talents to the laboratory as training instructors. At the same time, the campus has to send teachers to study in the enterprise. Considering the above five requirements, the campus-enterprise co-laboratory can greatly improve students' practical ability.

3.3. Laboratory management model and system guarantee

The laboratory adopts a joint management model, as shown in Figure 1.

Set up a laboratory management office to be jointly managed by the campus and the enterprise; In order to ensure the quality of internships, the campus makes full use of the strong scientific research and innovation environment of the engineering laboratory relied by the electrical major. And gradually form a hematopoietic mechanism of innovation and entrepreneurship for teachers and students.

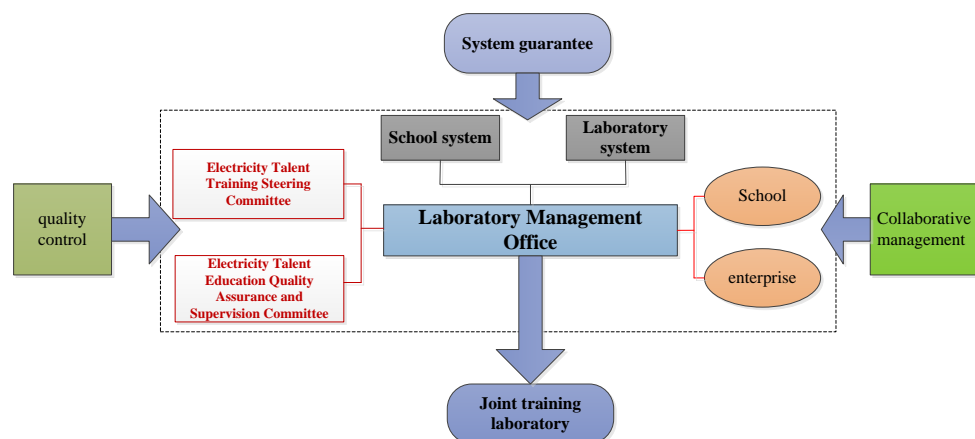


Figure 1: Laboratory management model.

Electricity Talent Training Steering Committee and Electricity Talent Education Quality Assurance and Supervision Committee implement supervision policies. Promulgate the campus system and laboratory system, and do a good job in the construction of system guarantees.

The construction of the laboratory is specifically based on the Institute of Integrated Measurement and Control, Dalian Polytechnic University, Dalian Power Supply and Smart Micro-grid Laboratory, and Dalian Key Laboratory of Smart Micro-grid and Green Recycling Industry. And the construction of laboratories requires a variety of flexible cooperation modes between professions and laboratories. The campus and cooperative enterprises jointly establish more various laboratories and practice bases. The laboratory is highly open to students majoring in electrical engineering, and is jointed with the Institute of Integrated Measurement and Control of the College. Instructors and students in the laboratory form research interest groups in different directions, such as the Power Group, Green Energy Group, etc. The laboratory provides students with a superior experimental environment, implements scientific and rigorous management.

4. The implementation of the joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents

The core goal of the joint training model of the campus-enterprise co-laboratory is to cultivate professional and technical talents suitable for social needs. If the laboratory wants to improve the professional and technical ability of the students, it needs to pay attention to the students' practice links. Through practical training, students can not only combine the knowledge they have learned with practice, but also improve their own qualities, such as the cultivation of teamwork spirit, hard-working exercise, the cultivation of interpersonal skills, and the cultivation of psychological resistance to stress, etc. In order to enable students to achieve their expected goals through the training process, the specific implementation is as follows:

1) Held a seminar on the joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents

In order to implement the joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents better, the campus needs to hold regular seminars on the training model of the electronic engineering talents., In addition, the campus needs to invite the relevant person in charge and technical personnel of the enterprise to put forward some specific suggestions for the current training of electronic engineering talents in laboratory.

2) Cultivate students' engineering awareness

The early stage of scientific research projects of cooperative enterprises or laboratories need to invest in advanced engineering equipment. The campus joints with cooperative enterprises to build laboratories based on the scientific and technological talent resources of universities and the existing laboratory platform. The purpose is to carry out the "Practical Skills Training Project for Fresh Graduates Majoring in New Energy in Universities ", and to provide a good environment for students' innovation and project implementation. The campus saves the purchase cost of teaching equipment, and at the same time, the campus fully taps the professional resources of the existing traditional laboratory. The campus strives to cultivate students' practical ability and innovation and entrepreneurship in the process of turning waste into treasure. University teachers and students have the opportunity to practice the most cutting-edge equipment and products. This can make up for the deficiencies caused by the relatively lagging textbook knowledge and the original laboratory conditions. The training model stimulates students' interest in learning, at the same time enhances their hands-on ability, and cultivates students' engineering awareness. Students not only learn advanced technical knowledge, but also come into contact with the management mode of engineering projects. The purpose is to let students understand the difference between engineering practice and experimental teaching, and enhance their sense of urgency.

3) Stimulate the enthusiasm of enterprises to create a win-win model

University laboratories are not only the main base for student practice, teacher research and subject exchanges, but also the promotion base for new products of the enterprise. Cooperative enterprises deliver their products to universities and at the same time promote themselves. The students received the enterprise's product training during the campus days, and subtly accepted the enterprise's product design and use concepts. So, the students naturally gave priority to this product, which invisibly expanded the enterprise's market share. Moreover, the enterprise participates in the training of students.

And it will choose outstanding students to stay in the enterprise. Students can play a role in their jobs immediately after graduation. This shortens the process of enterprise retraining, and it is important to select reserve talents for the further development of the enterprise.

4) Promote teachers to improve their own level

The content of traditional experimental teaching is old-fashioned and the structure is single, and it does not require the professional level of the teachers is very high. After the establishment of the campus-enterprise co-laboratory, the cutting-edge technology is updated quickly. So, teachers need to improve their professional level in time to adapt to the new teaching content. At the same time, the improvement of teachers' professional level will in turn promote the quality of experimental teaching. Students can learn more practical knowledge in the experimental class. In addition, the campus strengthens the training of experimental teaching staff can improve the professional ability of experimental teachers. And the campus invites technical personnel from enterprises to come to the campus for training, which can impart current advanced technical knowledge and industry standards to teachers and students. Efforts should be made to improve the professional ability and professional quality of experimental teaching staff. University teachers and enterprise professional technicians should jointly participate in the formulation of laboratory plans. They need to make a key summary of the new theories, new technologies, and new methods used in experimental teaching. And they should improve the teaching plan and teaching methods, and then better take on the important task of experimental teaching and cultivating students' innovative ability.

5) Actively participate in science and technology competitions and innovation activities

The campus-enterprise co-laboratory aims to use the enterprise's advanced technical equipment and the campus's excellent learning environment to cultivate students' ability to think independently, analyze and solve problems. Companies and laboratories can hold science and technology competitions based on ongoing science and technology projects. After studying in the co-laboratory, students can not only master the equipment and instruments of the laboratory, but also use the knowledge they have already mastered to achieve the results required by the competition. At the same time, students are encouraged and supported to participate in the relevant work of engineering practice projects undertaken by teachers or enterprises. Students directly participate in actual scientific research activities, which can improve their innovative spirit and practical work ability.

5. Practical effect

The implementation of the joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents will bring about a win-win result for universities, enterprises, and students. First of all, the professional and innovative talents jointly trained by the campus-enterprise which have professional talent quality and knowledge skills, and them meets the needs of enterprises for applied innovative talents. These application-oriented innovative talents will reduce the secondary processing cost of talents for enterprises, and ultimately promote enterprise development and industrial progress. Secondly, the implementation of the joint training model of the campus-enterprise co-laboratory will update the knowledge of participating experimental teachers, improve their professional capabilities, and promote the quality of experimental teaching. In addition, technical personnel of the enterprise will participate in the laboratory as part-time instructors. This can make the training of students' skills closer to the needs of society and solve the employment problem of students. Finally, the campus-enterprise joint training has stimulated students' interest in learning, and at the same time has enhanced students' innovative awareness and practical ability.

6. Conclusion

The practice of the joint training model of the campus-enterprise co-laboratory for the application-oriented electronic engineering talents in our campus shows that this model is a universally practical engineering practice teaching model. The model is worthy of deepening and promotion. The graduates trained by this model have a strong sense of innovation. And they have strong ability to work independently, and are good at thinking and teamwork. In addition, the graduates trained by this model are closer to the requirements of the market and industry. The willingness of enterprises to further cooperation is very strong, and the multi-win effect is truly realized. We will continue to promote campus-enterprise cooperation with an active attitude, expand cooperation with increasingly fruitful results. We will gradually realize the benign development between campuses and enterprises, and

continuously enhance the effectiveness of campus-enterprise cooperation. The purpose is to train more skilled and practical talents for economic and social development.

Acknowledgements

Authors thank for the financial support by Natural Science Foundation of Educational Department of Liaoning Province (Grant: J2020053), The University-Industry Collaborative Education Program form Department of Higher Education of Ministry of Education (201902019017), Technology Innovation Fund (Grant: 2020JJ26GX029) and would like to express many thanks to the support of Dalian Key Laboratory of Smart Micro-grid and Green Recycling Industry.

References

- [1] Gong, P.J. (2011) *Analysing the School-enterprise Cooperation Model of Higher Vocational College*. *Weifang Higher Vocational Education*, 7, 45-47.
- [2] Zhang, H., Cheng, X., Luo, Y. (2019) *The Role of Modern Apprenticeship System in School-enterprise Cooperation*. *Vocational Technology*, 18, 15-18.
- [3] Zhu, M., Zhang, J., Bao, S. (2011) *Research on the Cultivation of Logistics Engineering Application Talents by the Diversification School-enterprise Cooperation*. *Procedia Engineering*, 15, 4173-4177.
- [4] Du, S., Shan, S. (2012) *Inspiration of Cooperation between School and Enterprise in Germany and USA to China*. Berlin, Heidelberg: Springer Berlin Heidelberg, 135, 667-672.
- [5] Wang, J., Xu, L.B. (2011) *Study on Bidirectional Flow Ways of School and Enterprise Resources Based on Deep Integration*. *Education and Vocation*, 8, 21-23.
- [6] He, Z., Xie, L., Li, Y. (2017) *On the Improvement of School-Enterprise Cooperation (SEC) in China*. Dordrecht, Netherlands: Springer International Publishing, 24, 285-302.
- [7] Wang, Z.C., Li, G.F. (2011) *Exploration on the Construction of School-enterprise Resource Sharing Training Base*. *Education and Vocation*, 15, 45-47.
- [8] Gao, D., Liu, M.Z., Ji, J. (2009) *To Set Up Experimental Teaching Center Featuring Shared Resource between Universities and Enterprises*. *Research and Exploration in Laboratory*, 28, 101-102.
- [9] Song, W., Peng, L., Xiao, Y. (2014) *Cultivation of the Ability of Practice and Innovation of Computer Major Students by Skills Competition*. *Education Research Frontier*, 4, 52-56.
- [10] Wen, W., Zheng, Y.W., Chen, J.Q. (2010) *Analysis of the Education Model of School-enterprise Cooperation about Guizhou Vocation*. *Journal of Tongren Vocational & Technical College (Natural Science Edition)*, 8, 58-62.
- [11] Jie, L., Xiao, L., Liu, C. (2018) *The Discussion on the Improvement of Talents Cultivation in Food Specialty Based on School-enterprise Cooperation*. *Journal of Harbin Vocational & Technical College*, 6, 77-79.
- [12] Wang, Y.H., Bai, H.H. (2007) *Analysis on Cooperation Patterns between Higher Engineering Vocational Colleges and Enterprises*. *Journal of Shanxi Vocational & Technical College*, 3, 7-10.