



# Innovation and Practice of Collaborative Education Mode of Integration of Embedded Technology and Application Specialty

Jianbao Zhang, Shiping Bao<sup>(✉)</sup>, and Bing Luo

Guangdong Mechanical and Electrical Polytechnic, Guangzhou, Guangdong, China  
baoshiping@gdmec.edu.cn

**Abstract.** Based on the analysis of the common problems of industry education integration and collaborative education, this paper expounds the practical process of the embedded technology and application specialty of Guangdong Mechanical & Electrical polytechnic in the aspects of teacher construction, talent training reform, scientific research and social services, and focuses on the intelligent cooking robot, the uncivilized driving safety system based on fatigue detection, and the intelligent moxibustion robot, of which three typical cases introduce the practical process and results of school enterprise cooperation in cultivating students' innovative consciousness, strengthening students' innovative application and improving students' scientific research and practice ability.

**Keywords:** Integration of industry and education · Intelligent terminal · Electromechanical integration · School enterprise collaboration · Scientific research practice

## 1 Introduction

Under the background of the “double high plan”, deepening the integration of industry and education has become an important direction of the development of vocational education. The state has issued many documents on the integration of industry and education, such as the opinions of the General Office of the State Council on deepening the integration of industry and education, the policies and systems for the development of vocational education, such as the construction of “double highs” of vocational education and 20 articles of Vocational Education. However, in general, the policy dividend of industry and education integration has not been transformed into the internal driving force of school enterprise cooperation, and the depth of industry and education integration is still insufficient. The main conditions are as follows: (1) many colleges and universities, especially the teaching materials of engineering majors, the talent training program, are backward, disconnected, or even inconsistent with the demand for vocational skills required by the current industry development. (2) most school enterprise cooperation is mainly in the form of order class, modern apprenticeship, internship post provision, training base construction and other cooperation contents, but there is no guarantee and

incentive mechanism, the level of school enterprise cooperation is not deep enough, and the cooperation effect is difficult to guarantee; (3) the construction of the training base lags behind the actual situation of the industry, seriously affecting the training quality of students and the matching degree of the industry; (4) The teachers and scientific research force are weak, which can not provide technical support for the upgrading of enterprise products.

## **2 Innovation and Application of Collaborative Education Mode of Production Education Integration**

The embedded technology and application specialty of **Guangdong Mechanical & Electronical polytechnic** focuses on the innovation and practice of teacher capacity construction, talent training reform, and scientific research and training base construction in view of the dilemma of industry education integration and collaborative education [1].

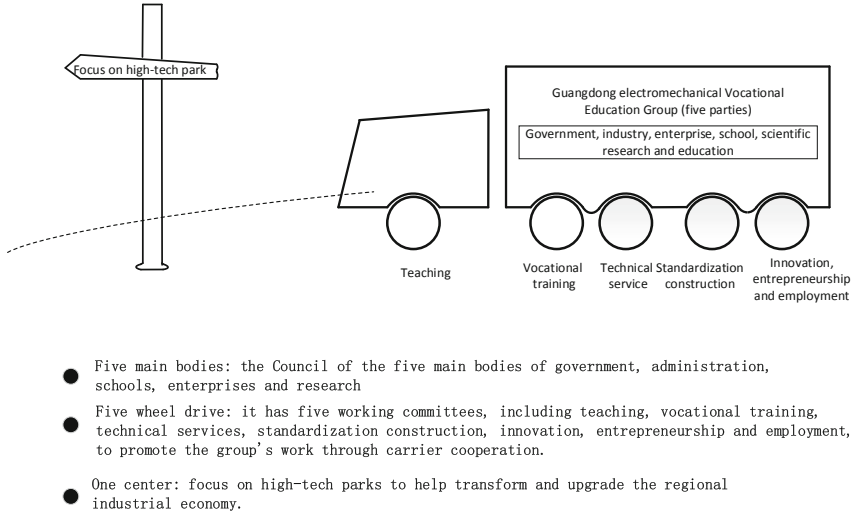
### **2.1 Innovation and Application of Collaborative Education Mode of Production and Education Integration**

#### **2.1.1 Guangdong Electromechanical Vocational Education Group “551” Operation Mechanism**

Guangdong electromechanical vocational education group administers 177 member units, including 2 local governments, 11 industry associations, 17 secondary and vocational schools, 142 enterprises and 5 research institutes. The membership structure covers the five main bodies of “land, bank, school, enterprise and research” [2]. Based on the five wheel drive of “teaching, standardization construction, innovation and entrepreneurship and employment, technical services and vocational training”, focusing on the one center of “regional economic transformation and upgrading, collaborative innovation and collaborative education”, we will intimate the talent demand of regional economic development, deepen school enterprise cooperation, accurately meet the talent demand, and improve teachers’ scientific research and social service ability. The operation mechanism block diagram of Guangdong electromechanical vocational education group is as shown in Fig. 1.

#### **2.1.2 Build an Intelligent Manufacturing Industry College in Multiple Ways to Build a Community of Interests and Development**

The specialty of embedded technology and application is affiliated to the College of electronic communications, and the College of intelligent manufacturing industry is jointly built with the College of advanced manufacturing of the University. The Industrial College relies on Guangdong electromechanical vocational education group. Gather high-quality scientific research institutions and enterprises such as national vocational education teams in the electromechanical industry, school enterprise practice bases, research institutes and leading enterprises in the industry, and build an intelligent manufacturing



**Fig. 1.** Operation mechanism of “551” organization [2]

industry college, a carrier of industry education integration. Through the top-level planning, the interests of enterprises, universities, teachers, students and other aspects in the industry education integration carrier are sorted out, and the rights and responsibilities of all parties are clarified; Perfect system and efficient operation mechanism, build a win-win interest and development community of industry education integration, build a special coordination organization, and be responsible for the planning, assessment, supervision and evaluation of the activities of industry education integration, so as to ensure the effectiveness of the operation of industry education integration organization.

**2.1.3 Improve the Two-Way Flow Mode of Talents and Build a Market-Oriented Education System**

Improve the flow mode of teachers and enterprise talents. Through regular training in enterprises, teachers can understand the latest state of industry science and technology, master new skills in combination with professional needs, transform them into teaching cases, and enrich students' horizons. Teachers participate in cooperative projects of enterprises and joint enterprises to declare scientific and technological topics, and improve teachers' engineering practice ability; By absorbing and introducing technical personnel with rich enterprise technology to teach students, we will build a teaching team with different technical specialties and diversified backgrounds [3].

Through the integration of industry and education, realize the collaborative education between schools and enterprises, based on the current talent needs of enterprises, further layout the needs of enterprise technological innovation, transformation and upgrading and regional economic development. Change the problem that traditional knowledge teaching methods are out of line with market demand, and set up curriculum content, talent training plan and teacher promotion plan based on market demand to improve students' employment competitiveness.

### **2.1.4 Innovate the Long-Term Operation Mechanism of School Enterprise Cooperation**

Promoting the interests of schools and enterprises, and the integration of school enterprise system culture, enhance the school enterprise cultural identity and interest identity, and lay a foundation for long-term and stable cooperation.

#### *1) Integration of school and enterprise interests*

School enterprise cooperation can not only rely on feelings or one-sided efforts. It is difficult to promote the deep integration of school enterprise cooperation without paying attention to returns. Therefore, it is necessary to comprehensively analyze the interest demands of enterprises, schools, teachers and students in school enterprise cooperation, and build an interest community of school enterprise collaborative education and multi-party participation. The goal of the school is to understand the demand for talents in the industry in real time through school enterprise cooperation, promote teaching reform, and improve the employment competitiveness of students; Through the integration of production and education, teachers can participate in the R & D and technology upgrading of enterprises, and improve their scientific research and social service capabilities; Through cooperation, enterprises can obtain students who accurately match the needs of enterprises, greatly reducing the investment in pre job training of interns and effectively reducing costs; At the same time, through school enterprise cooperation, the school can provide technical support for enterprise technology transformation.

#### *2) Integration of school enterprise system culture*

Both schools and enterprises need to examine each other's system culture, seek common ground while reserving differences, and learn from each other's strong points. The school builds a production education integration carrier according to the professional characteristics, and absorbs the excellent experience and ideas in the enterprise management system according to the professional characteristics, infiltrates into the professional skills training of students, and imperceptibly cultivates students' professional qualities.

In addition to absorbing advanced management of enterprises, the intelligent manufacturing industry college jointly built by high-tech enterprises in the region with precise docking of embedded technology and application specialty can also formulate standards, put forward requirements for enterprise system culture and promote the construction of cooperative enterprise system culture. At the same time, by means of "work study alternation" and "post practice" [4], students, as disseminators of school enterprise system culture, realize the integration of system culture.

## **2.2 Integration of Industry and Education Reform Talent Training Mode**

### **2.2.1 Strengthen the Construction of Education Practice Platform and Build a Solid Foundation for Talent Training**

Relying on the integration of resources of the intelligent manufacturing industry college, an intelligent terminal training base has been built. There are three scientific research centers including intelligent home appliances, mechanical structure design and artificial

intelligence. The scientific research center focuses on the comprehensive application of intelligent home appliance technology and artificial intelligence. On the basis of the common technology of intelligent home appliances, it undertakes transverse projects and scientific and technological projects of enterprises, accumulates project experience, and provides an innovative practice platform integrating the whole process management of project research and development, project industrialization and teaching for improving teachers' ability and cultivating students.

### **2.2.2 Improve the Collaborative Education Mechanism and Promote the Innovation Mode of “Learning, Doing and Creating”**

We will further promote the modern apprenticeship system and order classes, improve the school enterprise collaborative education mechanism, promote the two-way flow of school enterprise teachers, and the co construction, sharing and using of resources, promote the integrated teaching innovation mode of “learning, doing and innovation”, learn the core curriculum knowledge and key technologies of embedded product development, and “do” projects with real cases of enterprise intelligent terminals and intelligent manufacturing, Further apply or migrate the acquired knowledge to industrial engineering practice in other industries.

Schools and enterprises cooperate to set up a new type of apprenticeship class for enterprises: the enterprises independently determine the training objects according to the actual job requirements, and adopt the mode of “double teachers and apprentices, work and study alternating training, full-time or semi full-time training” with the school. The school cooperates with the enterprise to register the class apprentices for part-time education. In combination with the actual working and actual situation of the enterprise apprentices, the credit system management is adopted, and systematic professional knowledge, skill operation, safety production standards and professional quality training are carried out. The apprentice can obtain the graduation certificate issued by the school after completing the relevant credit accumulation.

### **2.2.3 Build High-Quality Curriculum Resources Around the Key Technologies of Intelligent Terminals**

Aiming at intelligent terminals based on Internet of things technology and artificial intelligence, focusing on the job skill requirements and professional qualities of corresponding industries and well-known enterprises in embedded technology and application, building industrial colleges closely around advanced technology skills, restructuring professional curriculum systems, and making curriculum resources closer to real work scenes; The course implementation process integrates the enterprise working environment and management mode, so that students can improve their professional quality and employment competitiveness while improving their skills with the times and the industry.

Schools and enterprises cooperate to jointly build high-quality professional core courses and excellent resource sharing courses, focusing on the construction of project-based teaching materials and course standards for intelligent cooking robots, intelligent

driving systems, and intelligent moxibustion robots, and forming a cultivation system of “basic common, core ability module combination”.

#### **2.2.4 Strengthen the Integration of Ideological and Political Education into the Professional Education System, and Further Stimulate the Resilience of Students to Learn Professional Knowledge**

Relying on the teaching platform of the College of electronic communications, the ideological and political elements will be organically embedded in the professional education system, and the moral training and value guidance will be strengthened while strengthening knowledge teaching and ability training [5]. Through the publicity of the core values of socialism with Chinese characteristics, such as the spirit of hard work, we will stimulate the enthusiasm of students for learning professional knowledge, enhance the sense of responsibility, overcome difficulties, face difficulties, and explore.

### **2.3 Integrating Production and Education to Improve Teachers’ Scientific Research and Social Service Capabilities**

The integration of industry and education aims at the needs of regional economic transformation, and cooperates with regional cooperative enterprises to build an innovative scientific research team of advanced intelligent manufacturing based on professional characteristics, technical reserves, development direction and other factors. College teachers improve their scientific research ability through training in enterprises, participating in the upgrading and transformation of enterprise projects, undertaking transverse projects of enterprises, and applying for scientific and technological projects in joint enterprises, so as to ensure that their business insight, technical vision and originality keep pace with the times and even lead the industry; By extracting advanced technologies and concepts from school enterprise cooperation projects and enriching on-the-job training and technical training materials, we can better improve teachers’ social service ability and better serve the needs of talent and technology development of regional enterprises.

### **2.4 Introduction and Analysis of Practical Cases**

#### **2.4.1 Participated in the Real Project of School Enterprise Cooperation, and Improved the Students’ Actual Combat Ability**

Relying on the school enterprise incubation project, students have obtained the practice opportunity of “learning by doing and doing while learning”, and their actual combat experience has been greatly improved. Taking the school enterprise project “intelligent moxibustion robot” as an example, this project is based on the traditional Chinese medicine hanging moxibustion and moxibustion techniques to simulate the movement of doctors’ hands to achieve accurate moxibustion treatment for users. Through the joint training of the school enterprise faculty team, students are guided to focus on the real moxibustion scene of “intelligent moxibustion robot”, carry out project innovation point mining and systematically planning and design, apply students’ knowledge and skills to innovation practice, and improve the actual combat ability of the student team. This

project won the provincial second prize of the 15th “Challenge Cup” Guangdong University Students’ extracurricular academic scientific and technological works competition (2019).

#### **2.4.2 “Project Driven” Promotes Multi-disciplinary Assistance and Strengthens Students’ Team Cooperation Ability**

The establishment of the R & D team is driven by the actual needs of the project, and then selects talents with different specialties and skills. The school enterprise incubation project “intelligent cooking robot” involves embedded technology application, electromechanical integration, electronic information, mechanical design and manufacturing, computer application technology and other disciplines. Through the establishment of student innovation teams in multiple majors, the real work scene of the enterprise was provided, inter professional communication and inter professional cooperation were realized, and the sense of responsibility and responsibility of the team students’ work were improved. The project was recommended by the 8th China International “Internet+” college students innovation and Entrepreneurship (2022) provincial competition.

#### **2.4.3 Improve Students’ Scientific Research and Practice Ability and Jointly Help Intelligent Driving**

Through introducing scientific research projects, schools and enterprises jointly cultivate and improve students’ scientific research practice ability, further guide students to combine scientific research with super intelligent driving safe driving system, and jointly realize the landing of scientific research projects. The super intelligent driving safe driving system based on image processing in this project mainly records and recognizes the driver’s facial expression and behavior by special cameras and fatigue detection terminals, so as to identify the driver’s fatigue driving and uncivilized driving. Face detection is performed by the camera to analyze the face orientation; Further determine the driver’s eyes, and analyze the closed state and frequency of human eyes in real time; Combined with the current vehicle running speed and the training model, the driver’s state is output intelligently. The project won the approval of Guangdong (2019) climbing plan and the first prize of Guangdong (2020) college student electronic competition.

### **3 Conclusion**

Through several years of teaching practice, the innovation and practice of the mode of production education integration and collaborative education of embedded technology and Application Specialty in Guangdong Mechanical & Electronical polytechnic has significantly improved the teaching effect, achieved remarkable results in improving students’ professional knowledge and development skills of embedded technology and application, and also improved the scientific research and social service ability of the teacher team. The details are as follows:

- 1) In the 2021–2022 professional skills competition of Vocational College Students in Guangdong Province, our school won 83 awards, ranking the fifth in Guangdong

Province, winning 15 first prizes, 36 s prizes and 32 third prizes. Among them, the embedded technology and application specialty has won 2 first prizes, 8 s prizes and 5 third prizes. The students' professional skills have been greatly improved through competition. More than 80% of the students in the specialty are engaged in the corresponding majors and are praised by the employers. Among them, more than 25% of the students are engaged in the design and development of embedded products, and the average salary ranks among the top three in the higher vocational category in Guangzhou.

- 2) Aiming at the key needs of the transformation, upgrading and innovation development of the intelligent manufacturing industry, we have created an innovative scientific research team focusing on the application of advanced intelligent electronic technology and intelligent structure design, which has promoted the "double upgrading" of products and technologies of electromechanical enterprises. The team applied for one national teaching innovation team construction project, won one first prize of the provincial excellent teaching achievement award, presided over one provincial education and scientific research platform, applied for one provincial industry and education integration platform, and applied for one provincial college student innovation and entrepreneurship training plan project. The amount of transverse accounts was more than 2 million yuan.

**Acknowledgments.** The authors would like to thank the Key Research Platforms and Projects of Guangdong, China (No. 2021KCXTD080, 2021ZDZX1103) for their supports in this research.

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