Research and Practice on the Hierarchical Training Mode of "Elite Class" of Electronic Information Specialty in Higher Vocational Education

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Abstract: Hierarchical training is an important trend in the development of domestic technical education in higher vocational education. The training of electronic information students in higher vocational education is particularly suitable for adopting the "elite class" mode. The specialty of Electronic Information Engineering and Technology in Shenzhen Polytechnic has designed a set of "elite class" talent training programs and operation management strategies for selection, evaluation, and withdrawal, which are suitable for the training of electronic information professionals at different levels. It has been practiced for 4 years since 2017, and the students trained have achieved great improvement and progress in academic performance, competition awards, employment salary and learning satisfaction. It is worth using for reference when the majority of Higher Vocational Electronic Information Majors carry out hierarchical training.

1.   Introduction

With the deepening of higher education reform, China has gradually formed a complementary higher education model of general higher education and vocational education. With the continuous improvement of the gross enrollment rate of higher education, the differences among students enrolled at higher education level, especially vocational education level, are gradually expanding[1-3]. There are great differences in students' academic ability, logical thinking ability and interests[1-3]. In the field of vocational education, electronic information specialty has the characteristics of broad connotation, involving a wide range of technical fields, and students have relatively more employment choices[4-6]. Based on the above reasons, it is necessary to cultivate students in different levels and categories. As a pillar industry of national GDP, the field of electronic information needs to cultivate a large number of technical elites in high-end industries[4-6]. Therefore, it is of great practical significance for vocational colleges to adopt the hierarchical mode to cultivate the technical skill elites of electronic information specialty, and try the "Elite Class" talent hierarchical training mode.

At present, some colleges and universities try to use "elite class", "experimental class" and other ways to explore the hierarchical segmented talent training, such as Changzhou College of Information Technology and H3C has signed the university cooperation agreement and opened the "network engineering Elite Class"[7]; the science experimental class of University of science and technology Beijing has carried out the innovative training mode of "one student, one plan" [8]; the medical and nursing specialty of Guangdong Lingnan Institute of Technology has adopted the "three points" (classification, segmentation, stratification) structure of the multi Collaborative Training Scheme [3].On the whole, the research and practice of hierarchical training of talents in higher vocational field is relatively less, and the related research of electronic information specialty is not mature. There are many problems, such as complex operation, imperfect talent training program, unclear training goal, low enthusiasm of students, and unsatisfactory learning effect. Since

2017, the electronic information engineering technology specialty of Shenzhen Polytechnic has tried to set up "Elite Class of Electronic Information Engineering Technology Specialty", carried out a series of exploration and practice, and achieved certain experience and results.

2. Setting of Training Objectives

The Outline of the National Medium and Long Term Education Reform and Development Plan (2010-2020) takes updating the concept of talent training, innovating the talent training mode, paying attention to the combination of learning and thinking, the unity of knowledge and practice, and teaching students in accordance with their aptitude as the important guidelines for the reform of the education system, and requires all kinds of education at all levels to adjust the education objectives in time according to their own development to adapt to the changes of the times [9]. With the continuous optimization and upgrading of the industrial structure, the training goal of higher vocational education has also embarked on a rising road from "having practical skilled talents needed by a specific occupation" to "compound innovative high-quality technical skilled talents", and then to "having top-notch craftsman elites in a certain technical field". The electronic information engineering technology specialty of Shenzhen Polytechnic (hereinafter referred to as "electronic specialty") has set up an Elite Class to teach students in accordance with their aptitude and cultivate them in different levels. Relying on the electronic skills competition, with the development of electronic innovation ability as the core, it promotes high-paying and high-quality employment for students, and provides excellent electronic design and application high-end technical skills talents for Shenzhen's electronic information industry.

3. The Organization and Management of "Elite Class"

3.1. Institutional Guarantee and Environmental Innovation

In order to ensure the smooth implementation of the training program, a working group for the Elite Class of electronic information engineering technology was set up, with consultants, team leaders, deputy team leaders, class teachers, course instructors and lecture instructors, responsible for policy formulation, overall planning, resource coordination, fund guarantee, organization and Implementation, course teaching, supervision and evaluation, etc. According to the regulations, in the second semester of each academic year, the college selects 25 students from the three-year and four-year higher vocational students of electronic information engineering technology to form a professional class—Elite Class.

The Elite Class has been running for one year since August every year, and the Elite Class is also used as the training mode of in-depth development. According to the design of "three education" mode, starting from sophomore, students can choose five main courses of other majors they are interested in and get credits [10] in addition to learning main professional courses according to the original class teaching plan.

In order to ensure the learning effect of Elite Class students, the electronic major breaks the traditional model. The school provides dedicated classrooms as a dedicated learning and training venue for elite classes, and each student is equipped with independent training equipment, including oscilloscopes, Dual-channel stabilized power supply, signal generator and multimeter, etc. Elite Class students concentrate on classes in a dedicated venue according to a specific timetable. Public classes and professional classes that are not part of the Elite Class courses return to the original class. After class, they need to concentrate on learning and training, avoiding the interruption and switching of the previous training operation process. The students of the Elite Class have concentrated classes in the special venues according to the specific curriculum schedule. For the public and professional courses that are not part of the Elite Class, the students return to the original class to study. In their spare time, they need to concentrate on learning and training to avoid the interruption and switching of the previous practical training process.

3.2. Selection Method and Assessment Management

3.2.1. Selection of Students

The selection process includes seven links: enrollment promotion, special lecture, student registration, closed book examination, interview, signing of the Elite Class volunteer letter and admission.

The assessment content is mainly based on logical reasoning questions, supplemented by professional knowledge and skills. The written examination (60%) + interview (40%) (the assessment index system is shown in Table 1) is used for assessment, and admission is arranged according to the score.

Table 1. Assessment Index System of Elite Class Enrollment

Test Method	Weight /%	Test Content	Weight /%
Written test	70	Logic reasoning	60
		Professional knowledge	40
Interview	30	Professional skills	40
		Professional quality	30
		Strain capacity	10
		Communication	10
		Manners	10

3.2.2. Selection of Competitors

Participating in the skills competition is the best platform for elite students to exercise their professional skills and prove their own strength. The selection of contestants is mainly based on students' daily performance, professional skills and other indicators. Considering that the psychological quality and professional skills of senior students are relatively mature, generally the third grade students are the main force of the competition, and the excellent second grade students can also participate in the competition. Junior students who are not selected to participate in the competition need to quit the Elite Class (retired) and return to the original class to continue their classes.

3.2.3. Assessment Management of Elite Class

The purpose of the assessment is to encourage students to study actively in the Elite Class and form an atmosphere in which everyone loves his major and everyone studies hard. During the period of studying in the Elite Class, the students will be assessed by formative assessment at the end of each semester. The students who pass the assessment can get credits. The students who fail to pass the assessment will be re studied, and those who are excellent in the assessment will be rewarded.

3.3. Rules for Elite Students

Table 2. Code of Conduct for Elite Students

Serial No.	Content
1	Must sign the elite class volunteer letter
2	The selected students participate in the skills competition and electronic design competition unconditionally, and are arranged for graduation practice in the college
3	Make a weekly plan and report the implementation of the plan to the tutor every week
4	19:30-21:00, Monday to Friday, need to check in and study in the evening; encourage students to study independently in elite classrooms in extracurricular time
5	Take good care of the classroom training equipment of elite class, and compensate for the artificial damage according to the price
6	Obey the management of tutor and class committee, do a good job in classroom learning atmosphere, environmental hygiene, etc
7	It is forbidden to engage in activities such as breaking the law, school rules and discipline in the classroom of Elite Class
8	It is forbidden to play games or engage in other activities unrelated to learning in the elite class

In order to standardize the behavior of the students in the Elite Class and ensure the steady

progress of the teaching order of the elite class, the code for students in the Elite Class is formulated, as shown in Table 2. Students participating in the Elite Class learning must comply with the school's student code and the requirements of the Elite Class code.

4. Talent Training Plan of "Elite Class"

4.1. Curriculum and Competition Arrangement

According to the plan, the period of study of the elite class of electronic information engineering technology is four semesters from the first semester of the second grade to the end of the second semester of grade 3. 30 credit courses are offered, and 15 credits and 14 credits related courses of major are replaced and expanded. The first semester course of grade two is mainly based on advanced application of single chip microcomputer and electronic circuit analysis and practice, supplemented by basic skills training of electronic technology, to help students get into STM32. In the second semester of sophomore year, Cortex-M3 / M4 and Android application development are the main tasks, supplemented by embedded real-time operating system application and machine vision technology, and two comprehensive practice projects are arranged to strengthen the comprehensive application ability of m3 / M4 and Android. In the summer vacation of the second grade, students are required to stay in school for training. In the first semester of grade three, we mainly prepare for the provincial trials of "Electronic Product Design and Production Competition" and "Embedded Technology Application Development Competition". In the second semester of grade 3, we will prepare for the national competitions of "Electronic Product Design and Production" and "Embedded Technology Application Development".

4.2. Credit Replacement

4.2.1. Three-year Credit Replacement Plan of Electronic Information Engineering

(1) 15 credits for replacement and development major;
(2) Replace the following course credits (14 credits in total):

Table 3. Replacement plan of three-year curriculum

Course Name	Credit	Semester	Remarks
Application of SCM 2	4	Term 4	
Sensor Technology	4	Term 4	
Application of Embedded System	4	Term 4	
Special training of Electronic Information Engineering 3	1	Term 4	Raspberry Pie
Special training of Electronic Information Engineering 3	1	Term 4	Comprehensive training of Electronic Design Competition

4.2.2. Four-year Credit Replacement Plan of Electronic Information Engineering

(1) 15 credits for replacement and development major;
(2) Replace the following course credits (14 credits in total):

Table 4. Replacement plan of four-year curriculum

Course Name	Credit	Semester	Remarks
Design of PCB	4	Term 4	
Development and Application of New-Type SCM	4	Term 5	
Application of Embedded System	4	Term 5	
Special Training of Electronic Information Engineering 1	2	Term 4	Advanced Training of Analog Circuit

4.3. Graduation Design Evaluation Method of "Combination of Exhibition and Evaluation, Focusing on Exhibition"

The graduation design of the "Elite Class" of the Shenzhen Polytechnic's electronics major innovated the original evaluation method and adopted the evaluation method of "combination of exhibition and evaluation, focusing on exhibition". On the day of the defense, the Electronics Professional Association will organize and arrange a special indoor exhibition venue, provide necessary power, table, chair, exhibition board and other facilities, and the exhibition will be set up by students in advance. At the exhibition site, volunteers will organize experts and teachers of defense group, lower-grade students and teachers of non-defense group to visit and vote for the exhibited works. At the same time, experts and teachers of the defense team will enter the defense venue after viewing the exhibition and voting, and the respondent students will enter the venue in turn to respond. The students waiting for the defense and the students who have finished the defense will continue to introduce their works in their booths and answer visitors' questions. The final graduation defense scores of students are shown in Figure1.
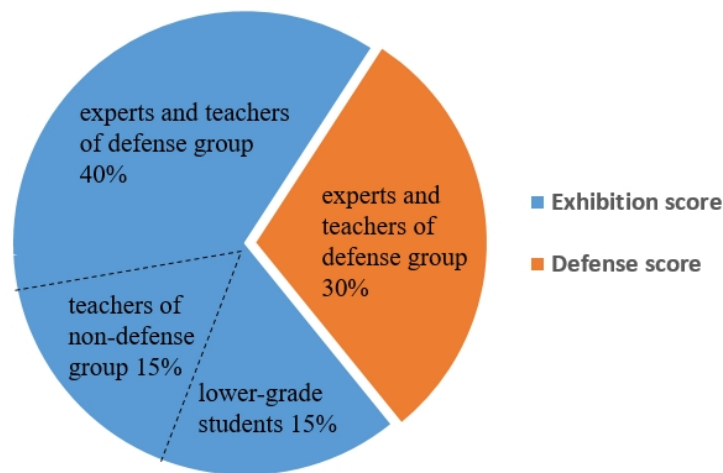

Figure 1. Score Composition of Graduation defense

5. Operation Effect of "Elite Class"

The "Elite Class" of Electronic Information Engineering Technology has been running smoothly for nearly four years since it opened in 2017. The first "Elite Class" students have graduated and successfully got employed. Among the 25 students in the class, 24 of them won the provincial level or above awards, and 6 of them won the national first prize. Compared with the students who participated in the National College Students' Electronic Design Competition, their achievements have improved significantly. Compared with the traditional class, more than 85% of the award-winning students come from the "Elite Class" or form teams with the "Elite Class".

At the same time, "Elite Class" students have also shown a strong advantage in employment after graduation. This study designed a questionnaire specifically for the 2017 "elite class" graduates, and conducted a return visit to the 2017 graduates to study their employment companies, salary levels and satisfaction with the talent training of "Elite Class", etc., and a total of 25 questionnaires were distributed , and 22 questionnaires were returned. Among them, 90.9% of students work in Shenzhen high-tech enterprises and are engaged in electronic information technology such as Shenzhen Gaokerun Electronics Co., Ltd., Unitech Technology Co., Ltd., Sunding Technology Co., Ltd., Tianyuan Semiconductor Co., Ltd. Companies, etc. The monthly average salary of students for one year after graduation is 6860 yuan, which is much higher than the average salary of the whole major. The one-year turnover rate of graduates is less than 9%. The average score of graduates' satisfaction with "Elite Class" training is 90.5 (full score is 100). It is generally believed that the curriculum and actual effect of elite class can fully meet the needs of employment and career development.

6. Conclusion

Since the "Elite Class" started operation in 2017, students' academic performance, various skill competition awards, participation in various activities, and various awards received by the school have all made great improvements and progress. After graduation, the 2017 elite class students have obvious advantages over the traditional training model in terms of employment salary, professional counterpart rate, and satisfaction with school teaching. It shows that the "Elite Class Talent Training Program", "Elite Class Student Selection and Class Management Mode", and "Elite Class Operation Mode" designed by Shenzhen Polytechnic have good practical results, which are effective for higher vocational students. The hierarchical talent training of colleges and universities has a good reference.

Acknowledgement

References

[1] BIE Dunrong, YI Mengchun (2021) Higher Education Popularization: Criteria, Process and Pathways. Educational Research, 2, 63-79.

[2] Xia Xue, Wei Xing (2020) Differences between Urban and Rural Students and among Family Classes in Higher Education Enrollment Opportunities :Based on the Survey of Five Provincial Universities. China Economics of Education Review, 2, 65-79.

[3] Huang Shanshan (2021) Research and practice of classified, hierarchical and segmented talent training scheme for medical and nursing majors in Higher Vocational Colleges. Journal of Higher Education, 9, 177-180.

[4] XU Linbo (2021) Strategy of Practical Teaching Reform of Electronic Information Majors of the Higher Vocational College. HEILONGJIANG SCIENCE, 2, 138-139.

[5] YU Fei, ZHAO Jie (2014) Teaching Semiconductor Device Physics in TVET: A New Approach. Journal of Shenzhen Polytechnic, 5, 77-80.

[6] WANG Jingxia, YU Fei and SONG Rong (2015) Course construction and teaching practice of "Introduction to electronic information engineering" in Higher Vocational Colleges. Journal of Shenzhen Polytechnic, 1, 48-51,55.

[7] YANG Xue, JU Guangming and ZHANG Weidong (2015) Analysis on the Training Ways of High-skilled Innovative Talents by the "Elite Class" Model in Higher Vocational Colleges: Taking the "Internet Elite Class" in School of Network and Communications of Changzhou College of Information Technology as the Example. Value Engineering, 2, 177-178.

[8] WEI Hongru, XU Mengsen (2021) "One plan for one student" training mode of science experimental class based on "new infrastructure". CHINA METALLURGICAL EDUCATION, 1, 82-85.

[9] GU Mingyuan (2010) Study and interpret "national medium and long term education reform and development plan outline (2010-2020)". Journal of Higher Education, 7, 1-6.

[10] WANG Wenge (2017) Higher Vocational Business English Professional Development "Discrete and Embedded,Explore the Teaching Mode of Enterprise Practice of Rolling Type" — Taking Shenzhen Polytechnic Business English Professional Development as An Example. EDUCATION TEACHING FORUM, 42, 226-227.