How Minority Majors in Industry-backgrounded Higher Vocational Colleges Serve Small and Medium-sizedenterprises -- from Modern Apprenticeship Perspective of IT Major in GRP

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Abstract

For a minority major in industry-backgrounded higher vocational colleges how to provide small and medium-sized enterprises with qualified talents, this paper demonstrates it. The IT major in GRP cooperates with the National Digital Family Base and Guangzhou Horizontal Information Technology co., Ltd, through modern apprenticeship, in realizing industry-education integration and college-enterprise cooperation. This paper solves the problems of the dilemma between generalization of industry talent needs and the personalization of talent training of hightech small and medium-sized enterprises, the imperfect operation mechanism in modern apprenticeship system, and the insufficient motivation of enterprise participation.

Keywords: *Modern Apprenticeship; Industry Apprenticeship Center; crowdfunding model*

0. Introduction

There are 4 major functions for Chinese higher education in the new period, including talent cultivation, scientific research, social service，cultural succession and innovation. Among them, talent cultivation is the core. The other 3 should be carried out around it, which should be realized through the other 3.

Chinese higher education, generally speaking, consists of ordinary higher education and higher vocational education. The former mainly deals with academic talents cultivation in some top universities through undergradute, master and doctor programs, and applied talents cultivation in most of universities through undergraduate and master programs. The latter, as a different type in the positioning from the Ministry of Education, should undertake the task of skilled and technical talent cultivation in most of 3-year colleges through integration of industry and education, college-enterprise cooperation.

1. The Problems Faced

For higher vocational colleges how to realize the function of talent training through integration of industry and education, college-enterprise cooperation? I will divide it into two aspects. First, for the main majors of higher vocational colleges with industrial background, like various railway majors of Guangzhou Railway Polytechnic (GRP), they have deep-rooted enterprise background, long-term college-enterprise marriage and firm reliability on large stateowned enterprises, which make their talent training function

easy, comparatively, to be fulfilled through the enterprise order-based class mode. For GRP railway majors, like railway power supply, locomotive driving and maintenance, this mode has become quite familiar. More than 60% of the graduates each year have entered the order-based class titled by the relevant enterprises, and most of the graduates are employed by large state-owned enterprises.

Second, however, the situation is quite different for the minority majors of higher vocational colleges with industry background, like the IT major in GRP. The industry background at the college level is not shared at large by this major, as only a small proportion of its graduates are recommended by the college and employed by related railway enterprises. Most of its graduates, however, have to be tailored for IT enterprises. What's worse is, some large IT enterprises are wondering why they will recruit graduates with a railway background education? Is it an advantage or disadvantage? The IT major in graduate employment is not only missing the industry- backgrounded advantages at the college level, but also facing an extra pondering from some enterprises. How will it position its talent orientation, finish its talent cultivation through integration of industry and education, college-enterprise cooperation?

I will skip the former, and focus on the latter, which is my research topic in this paper.

2. Solving Ideas

The minority major of IT in vocational colleges with industry background is neither benefited from the college recommendation in graduate employment in railway enterprises, nor given a fair chance, not to mention a short-cut, in large IT enterprises. How will it face the challenges, convert its disadvantages to strength, and accomplish the task of talent cultivation as well? Based on the past experience, I will put forward 2 solving ideas for it.

2.1. Positioning of Talent Cultivation

As some large IT enterprises in local areas prefer to employ IT graduates from universities with bachelor degree, the IT major in GRP has adjusted its poisoning orientation of graduate employment, focusing on small and medium-sized enterprises in the Pearl River Delta. The reason why the orientation is adopted is that "Small and medium-sized enterprises are the capillaries of the national economy, which play an important role in improving labor productivity, expanding employment, narrowing income gap, and promoting market competition", "they have taken up 50% of tax, 60% of GDP, 70% of technical innovation, 80% of employment, and 90% of enterprise numbers"[1]. As the small and medium-sized enterprises in the Pearl River Delta play so important roles in talent training, we shall give it a further consideration, so as to accumulate some experience in the reform. According the analysis of industry social background of talent cultivation positioning in the survey by the paper group, the result is like this: the positioning for a small and medium-sized enterprises in the Pearl River Delta, 34.8% stuff are technical supporters before and after sale, 17% stuff are salespeople, 16.7% are customer service providers,

14.9% are managing workers, 10.1% are quality controllers, and 6.5% are technical developers. That is to say, for a higher vocational college, it is better to reposition its graduates to small and medium-sized enterprises in the Pearl River Delta, and firstly to technical talents, and then to salespeople, etc.

[1] https://finance.sina.cn/zl/2021-12-20/zl-ikyamrmz0029687.d.html

2.2. Industry-education Integration and College-enterprise Cooperation

Since 2014, the pilot work of modern apprenticeship in vocational education in China has achieved rapid development. Thus in 2015, 2017, through Computer Application Technology major's marriage with the National Digital Family Base in Guangzhou University Town, the college and enterprise jointly participated in talent training, walked on a successful exploration road, continued to supply talents to small and medium-sized enterprises in the base. Through deepening industry-education integration, and college-enterprise cooperation, and focusing on the reform of talent cultivation mode of modern apprenticeship system, the talent cultivation of computer Application Technology major has won the first prize of 2017 Teaching Achievement Award of Guangdong Province and the second prize of 2018 National Teaching Achievement Award. In 2018, the Ministry of Education successively announced 163, 203 and 194 modern apprenticeship pilot units, which set off a modern apprenticeship pilot boom in the country.

GRP values modern apprenticeship pilot work. Since 2014, the number and level of modern apprenticeship pilot programs have increased. In 2014, GRP only had 2 pilot majors at the college level, and both of them were upgraded to provincial pilot majors. In 2016, two provincial-level pilot program were upgraded to national-level ones, and another two provincial-level pilot programs were added, bringing the total number to 4. In 2018, the national pilot majors remained unchanged, and 1 of the2 pilot programs was upgraded to provincial one. The total number of pilot programs remained unchanged. In 2020, GRP added 2 college-level pilot programs, and all of them were upgraded to provincial ones. So far, GRP has a total of 6 pilot programs, including 2 national pilot programs and 4 provincial ones, as shown in the table below.

Table 1: Apprenticeship Pilot Programs in GRP

Major/ Program	Enterprise	2014	2016	2018	2020	2022	Level
Application	National Digital Family Computer Base, Guangzhou Horizontal Information Technology Technology co., Ltd	16	16	53	21	18	ministry
Power Supply Mechanical and Electrical	China Railway Signal & Communication Co., Ltd (Changsha Branch)	3	37	27	23	-	ministry
Equipment Maintenance and Management	Guangzhou CRRC Urban Rail Equipment Co., Ltd	33	-	35	30	-	province
Tourism Management	China Hotel Co., Ltd	27	33	31	6	-	province
Applied Electronic Technology	Shenzhen Tianma Microelectronics Co., Ltd	-	44		8	3	province
Machine Building and Automation	Guangzhou Yuxi Technology Information Co., Ltd	-	-	-	13	-	province
Logistics Management	Qianhai Xuyi Information Technology (Shenzhen) Co., Ltd	-	-	-	-	11	province
Mechanical Design and Manufacturi Railway ng	Guangzhou Yuxi Technology Information Co., Ltd	-	-	-	-	1	province

3. The Concrete Measures

In order to effectively motivate enterprises to participate, and to enlarge versatility of apprentices' competency structure，this major，based on the tripartite cooperation of " college + industry base + small, medium-sized enterprises" in the exploration and practice, has formed a training mode for modern apprenticeship talents. After nearly 8 years of practice, the results are clear: the mechanism between talent training and industry/enterprises' motivation has been improved, a series of teaching resources have been developed, and the dilemma between the sustainable development of modern apprenticeship talent training and the personalized talent needs for small, medium-sized enterprises has been effectively solved.

3.1. Establish an Apprenticeship Center
GRP, the National Digital Family Base and leading company (Guangzhou Horizontal Information Technology co., Ltd. (hereinafter referred to as Horizontal)) formed a community of interests to manage the pilot program.

3.1.1. Positioning of the Apprenticeship Center
To solve the problem of coordination, the National Digital Family Base took the lead in building the apprenticeship center. The latter embodied the former in the whole process of management, responsible for: ① making the professional standards；②making the talent training scheme corresponding to the professional standards, meeting the common demand for all enterprises and personality need for one enterprise；③ coordinating the labor shortage among and between the enterprises; and ④solving the problems for apprentices in learning progress and other fields with GRP and the particular enterprise.

3.1.2. The Dynamic Model
A community of interests shall be formed by GRP, the National Digital Family Base, and one particular enterprise. The

responsibilities of each party shall be clarified as follows: GRP is the initiator and coordinator of apprenticeship training; the Apprentice Center participates in the whole process of apprenticeship training, including analyzing general vocational competency, providing the common talent training standard across the enterprise, decomposing the commonality mission across the enterprises and the personalized mission for a particular enterprise, and formulating the talent training scheme corresponding with professional standards; the particular enterprise undertakes the specific task of apprentice training, providing a two-way option between enterprises and apprentices for the apprentices. Thus, the 3 parties shall establish a new cooperative training mechanism in accordance with the principle of "GRP setting the target, industry setting the standards and the enterprise setting the position", as shown in diagram 1 below.
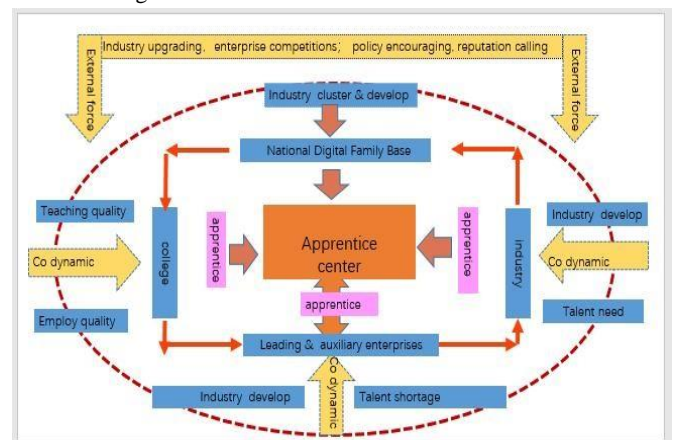

Diagram 1:The Dynamic Model Between College, Industry and Enterprise

3.2. Build Three-way Collaborative Mechanisms

3.2.1. Establish a Crowdfunding Mechanism for Enterprise

Given the status quo that the industrial clusters in the base have large and continuous demands for technical talents, while a single enterprise doesn't, it is proposed that the enterprises through crowd-funding manner participate in talent training, that is, the apprenticeship class of the college does not cooperate with only one enterprise, but with several enterprises in the base, jointly finishing the apprenticeship training task.

As the leading enterprise in the base, Horizontal unites several enterprises from the upstream and downstream of the industrial chain to undertake apprenticeship training in the form of crowd funding. As the leading enterprise, Horizontal has to undertake a series of responsibilities, thus has the priority in apprentice selection. The auxiliary enterprises participating in crowdfunding have the right to know the whole process according to their respective responsibilities, but their rights to select apprentices are subordinate to those of leading enterprises, and can only choose apprentices after the leading enterprise.

Through crowdfunding, enterprises will more voluntarily participate in the modern apprenticeship, and be more willing to increase investment in education. Only multiple enterprises with common needs of talents can support an apprenticeship class, while the change of auxiliary enterprises is allowed. In this way, the problems in modern apprenticeship like the stability of talent demand, and the persistence of the pilot practice, can be solved to the greatest extent.
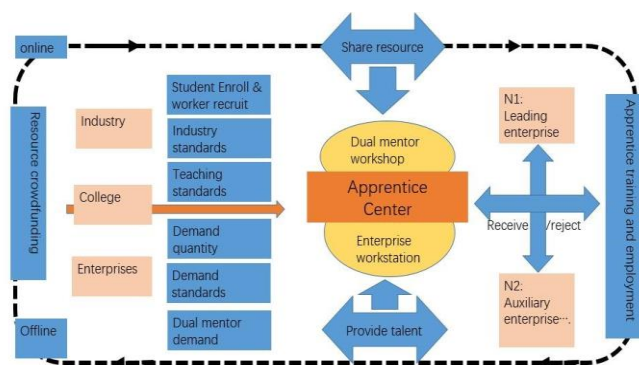

Diagram 2: Crowdfunding Mechanism

3.2.2. Refine the Cost-sharing Mechanism

After clarifying the responsibilities, rights and interests of all stakeholders, the mechanism for sharing funds is refined and a year by year plan for sharing funds is work out. GRP shall bear the teaching operating expenses related to apprenticeship training; The enterprise undertakes all kinds of expenditure of productive teaching tasks, including paying the master's allowance, apprentice's salary, providing necessary facilities and equipment and corresponding production conditions for apprentice's teaching, etc. As the coordinating organizer, the industry provides industry standards and shared resources, and undertakes the expenses of teaching space, training equipment, water and electricity consumables and living subsidies for apprentices in the nonproductive process. According to whether the apprentices have the capacity to produce, the apprentices' wages are divided into subsidies and salary, which not only reflect the basic rights and interests of apprentices and "productive" attributes, but also take into account the enterprise management attributes.

3.2.3. Integrate a "Enrollment + Recruitment" System

The joint training contract for modern apprenticeship is signed by the college, industry and enterprise, led by GRP. The standards are determined by the industry, the posts by the enterprise, thus the integration of enrollment and recruitment implementation system is determined. The admission outline is formulated, the publicity is made, the examine paper is proposed, and the interview is organized by the 3 bodies jointly. For the students who meet the requirements and are planned to be enrolled, the "student-industry-enterprise-college" contract will be signed when the letter of admission is issued to ensure the dual status of apprentices legally.

3.2.4. Form a College-Department-Program Mechanism

GRP has set up a modern apprenticeship leading group headed by college leaders, responsible for top-level design, and issued a series of eight documents like *On the Management of Modern Apprenticeship Talent Cultivation (Trial)*. The subordinate schools and departments have set up special groups of school-enterprise dual-leader system for pilot work, and implement various tasks of apprentice training relying on enterprise workstations and teachers' workshops. A professional working group was established for the pilot programs, and a teaching process file package was prepared according to the professional teaching standards, to standardize the teaching operation and organization.

3.3. Develop Professional Teaching Standard

Taking "trial entry → project experience → system installation and commissioning → system maintenance → system integration design → project organization and implementation → multi-project coordination and management" as the main line, the course system combining

"work + study" based on work process is constructed, forming the teaching standard of

Computer Application Technology program in Guangdong Province.

3.3.1. Form a "3 in 1" Curriculum System

Occupational skills for apprentices are divided into "knowledge skills, basic skills and post skills", thus a curriculum system of "occupational literacy + general industry ability + post specific skills" is formed.

3.3.2. Innovate a Task-driven Teaching Method

Based on the typical tasks of apprentices, the apprenticeship competency is divided into productive tasks and non-productive tasks, different courses are arranged respectively. The nonproductive tasks are aimed at the common tasks of the industry, and they mainly cultivate the industrial adaptability of apprentices; Production task is an alternative position for apprenticeship employment. Training the competency of apprenticeships is a real job task of enterprises, which is completed by teachers and apprentices on the production site. Thus the task-driven teaching method of professional apprenticeship course was innovated.

3.3.3. Make Curriculum Standards

Develop theory-teaching projects in the college, and practice ones in enterprises, and integrated the core knowledge and competency into curriculum standards, to ensure that there is a common recognition of professional competency for apprentices in different enterprises, to solve the problem that the learning outcomes of apprentices is not recognized by different enterprises.

3.4. Form a "3x3" Teaching Mode to Realize Dynamic Adjustment for Talent Training.

3.4.1. Design "Three-place-alternation" Teaching Arrangement

Students (apprentices) receive education in 3 places of GRP, Apprenticeship Center and enterprises. The teaching arrangement is implemented like this: the exchange between college and enterprise courses is adopted within every week, and the proportion of enterprise courses to college courses will be gradually increased by semester. That is, in the first semester, the ratio of college and enterprise courses is 4:1 per week, for 4 days the students stay in GRP to finish college courses, and 1 day in the enterprise to finish enterprise cognitive practice. In the second semester, the weekly ratio of college and enterprise courses is 3:2, for 3 days the students stay in the Apprenticeship Center to finish college courses, and 2 days in the enterprise to finish the practice of post projects. In the third semester, the ratio of that is 1:4, 1 day in the Apprenticeship Center to finish college courses of professional theory, and 4 days in the enterprise to finish the practice of post projects. In the fourth semester, the ratio of that is 0:5, students stay in the enterprise to finish multi-post on-job training, and carry out the post project practice 5 days a week. Then the enterprise will take the leading role in implementing the plan, the enterprise tutors will lead the apprentices directly, the college tutors will give some guidance once in a while.

Table 2: Increase of Enterprise Courses to College Courses

Semester	College : Enterprise Ratio	Teaching Place	College Course	Enterprise Course
1	4:1	College & enterprise	4 days of integrated courses	1 day of enterprise cognitive practice
2	3:2	Apprenticeship Center & enterprise	3 days of integrated courses	2 days of practice of post projects
3	1:4	Apprenticeship Center & enterprise	1 days of integrated courses	4 days of practice of post projects
4	0:5	Enterprise	0	days of multi-post on-job training

Notes: it is a 2-year program.

3.4.2. Develop a "Three–level-progression" Ability Training System

According to the cognitive rules and skill acquisition rules of the industry, apprenticeship training courses are divided into college courses and enterprise project courses, and the teaching content is divided into three parts: "basic knowledge - common tasks of the industry - personalized tasks of the enterprise", so as to realize the integration of college courses and enterprise courses.

3.4.3. Implement a "Three-teacher-combination" Tutoring Way

Relying on the college teachers' "enterprise workstations", and the college-enterprise "double teacher workshop", the college, enterprise and industry jointly set up the double teaching team.

College teachers are responsible for public basic courses and professional basic courses; Apprenticeship center teachers are responsible for the core modular training courses of the industry, while enterprise masters are responsible for the skill courses of their own special positions.

3.4.4. Integrate the College and Enterprise Culture

Through industrialization, enterprization, and professionalization, with the help of enterprise courses on the site, the college teachers join hands with enterprise masters in reforming the public courses, integrating the connotation of industry, enterprises, professional culture, and the competency of current politics analysis, data analysis and practical writing, thus to cultivate the craftsman spirit for the apprentices, like dedication, bettering, focus, and innovation.

3.5. Construct a "Three-level & four-dimension" Evaluation System

The "three layer & four-dimension" evaluation system is designed and implemented, with appraisal and feedback system included. The three level refers to the progressive assessment target of quality, profession and post, which means the apprentices are evaluated from professional basic quality, professional basic skills, and post competencies. The four dimensions refer to personal quality, professional attitude, professional experience and job skills, which means the apprentices are evaluated from the above-said 4 dimensions. The evaluation is carried out at the end of each learning stage. Apprentices who are rejected by N1 enterprise will be returned to the apprenticeship center. After re-training, they will be selected by N2 enterprise... Until they are employed.
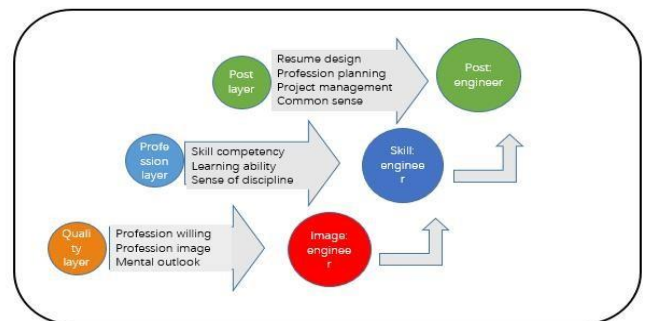

Diagram 3: Three-level Evaluation

3.6. Develop a Management Platform

Based on the characteristics of the apprentice training, a management platform with multifunctions of partial professional knowledge database, apprentice management, teaching management, was built, to meet the need of self-learning of apprentices, auxiliary teaching need of teachers and masters, and talent selection function of enterprises. In this way, the combination of teaching process management, enterprise need crowdfunding, and apprentice status management become possible, and the online and offline teaching, interaction, and management is well rooted.

Diagram 4: Management Platform
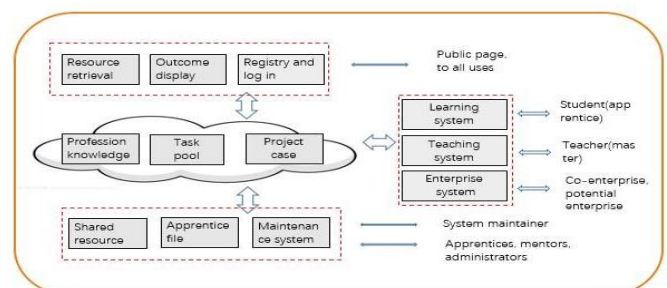
4. Effect of the pilot apprenticeship for non-major majors

4.1. The quality of talent training has improved markedly

The practice has been carried out in IT major of GRP for 9 years, and 124 graduates have been trained. Compared with the ordinary class, the quality of talent training has been improved significantly, the job opportunities for apprentices after graduation are more, students, parents, enterprises and teachers are quite satisfied, and the enrollment and employment rate is more than twice that of the ordinary class. The employment rate is 100% for two consecutive years, and the starting salary is more than 25% higher than that of ordinary class students; 30% of the students are promoted to be department supervisors or technical backbone within one year after graduation. In the past five years, more than 50 provincial and above skills competition awards have been won by the students, and 15 provincial and municipal innovation projects have been given to the teachers.

4.2. The connotation has achieved remarkable results

After three years of practice, the modern apprenticeship of IT major has been listed as one of the first batch of National Modern Apprenticeship Pilot Projects, and one of provincial pilot projects as well. The IT major has been listed as one of Key Majors at provincial level. The "enterprise + college" teaching team has been given the tittle of Provincial Outstanding Teaching Team. The team has got 15 national patents, published 21 related teaching and research papers, and 4 professional textbooks, and 7 practical textbooks.

Table 3: Comparative Table of Graduate Employment from Apprenticeship and Ordinary Classes

evaluation index	2017		2019		2021	
	apprentice	ordinary	apprentice	ordinary	apprentice	ordinary
Apprentice number	16	35	16	30	53	25
graduation rate	95%	87%	100%	91.5%	100%	76.2%
Employment rate	100%	100%	100%	96.88%	100%	70%
Professional qualification rate	100%	100%	100%	100%	100%	100%
starting salary (month)	2500	2000	3500	3000	4250	3400
one year salary after graduation	3300	2800	5310	3960	4509	4210

4.2. the influence at home and abroad is significant

The education Department of Guangdong province highly appraised this achievement and listed it as one of the seven typical models of modern apprenticeship in Guangdong province. In

2015, it was selected as one of 216 typical cases in "Higher Vocational Education Innovation and Development Achievement Exhibition" by the Ministry of Education.

At the invitation of the International Modern Apprenticeship Innovation Network (INAP), project leaders presented their experiences at the 6th International Research Conference on Modern Apprenticeship. The results have been included in the UNESCO TVET Practice Case Base as a typical example of modern international apprenticeship.

Reference：

1. Ren Zeping：2021 Research on management status of micro, small and medium-sized enterprises in China [EB/OL], (2021-12-20) [2023-11-04].https://finance.sina.cn/zl/2021-1220/zl-ikyamrmz0029687.d.html.