Research And Practice: The Practical Teaching Mode Of Modern Mentoring System Electrical Engineering And Automation In Kashi University Is Taken As An Example

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Keywords: Modern Mentorship System; Double-Qualified Teacher; Practical Training; Talent Training; Teaching Mode.

Abstract: Kashi University has implemented a four-year practice of "modern mentorship system" for all the undergraduate students majoring in electrical engineering and automation. Taking it as an example, this paper introduces the practical process of combining virtual and realistic teaching with "modern mentorship system" talent training mode in practical teaching. It summarizes the experience in the construction of teaching mode and training system in the "modern mentorship system" teaching practice process, including the setting and construction of training room, the requirement and cultivation of tutor's teaching skills, and the setting and development of practical training content. Through the reflection of education, this paper analyzes the restrictive factors of the practical teaching mode of "modern mentorship system" in teaching practice, and provides the coping strategies in the process of teaching organization. This paper also puts forward the construction method of the teaching system based on the modern mentorship system in engineering practice teaching, and gives the practical teaching scheme to satisfy the practical teaching in some special areas where sufficient real training places are unavailable, and to ensure the seamless connection between the teaching in the school and the real job.

1. Introduction

Technology application-oriented colleges are a type of adjustment of the direction of undergraduate education by the Ministry of Education of the People's Republic of China based on the demand for cultivating high-level technical skills talents. which aims to enable each type of colleges and universities to "optimize their structure and run their own characteristics."The "Decision of the State Council on Accelerating the Development of Modern Vocational Education" requires pilot promotion, demonstration and guidance to guide a group of ordinary undergraduate colleges and universities to transform into applied technology colleges and universities.[1] Kashi University is one of the transformational technology application-oriented universities. In the practice of transformation, we combined the characteristics of regional industrial development in southern Xinjiang, and implemented the development concept of applied technology university in the talent training scheme for electrical engineering and automation majors. The key link of applied teaching mode lies in practice and training teaching. The ideal goal of application-oriented talent training is that the operational skills of talents trained in colleges and universities should be adapted to the actual working environment, that is, they can meet the requirements of the post when they go to work". As far as engineering training and teaching is concerned, the teaching environment needs to be real, the students in the same class structure should conduct training simultaneously, and the teaching links should be carried out as planned. These needs do not match the links provided by the actual factories and mining enterprises outside the school.

In terms of electrical engineering and automation majors, it is impossible for a power supply company to accept simultaneous training in the same venue for students in the teaching class, and the real working environment with high-voltage power supply and distribution does not allow students to carry out design and operation exercises and a complete training also cannot be achieved

in all directions in a real production environment. In addition, Kashi is located in the border area and has a weak industrial foundation, and thus the factory and mining enterprises that can provide practical training for electrical specialty are insufficient. Therefore, in the teaching of electrical engineering and automation professional training courses, we creatively designed the education model of the modern mentoring system, and established a teaching team with dual-qualified teachers as the core. From the entry of undergraduates to employment, the four-year consistent system implements the training of the mentoring model, using a combination of virtual and reality methods, Step by step, cultivate students' practical skills. The content covers the whole process from the proposal of a practical task to its completion. It has achieved good results in the teaching practice of application-oriented talent training.

2. The background of the formation of the teaching model

2.1. Three Problems in the Construction of Technology Application-oriented Undergraduate Universities

Both the "National Medium and Long-term Education Reform and Development (2010-2020) Planning Outline" of the People's Republic of China and the "Decision of the State Council on Accelerating the Development of Modern Vocational Education" point out the need to vigorously cultivate applied, compound, skilled, and innovative talents. This line of thinking has guided the development of a group of engineering colleges aimed at cultivating first-line technical talents towards technology-application-oriented undergraduate colleges in the new era. In the implementation path of cultivating talents for such engineering majors, it is more inclined to cultivate students' hands-on ability and practical ability, which is different from academic training strategies. Technology application-oriented colleges and universities require teachers to have double quality, practical teaching sites tend to be authentic production-research environments, and curriculum development focuses more on combining practical work rather than academic research. The training of teachers' quality, the construction of training venues, and the development and construction of courses are issues that must be reformed in the process of transforming colleges and universities to application-oriented.

2.2. Modern apprenticeship model

Modern apprenticeship is a form of education that combines school-form vocational education with natural-form apprenticeship. It originated from vocational training in Federal Germany and was widely implemented in developed countries in the 1980s.[2] In 2015, the Ministry of Education of the People's Republic of China issued the "Opinions on Carrying out the Pilot Work of Modern Apprenticeship", and proposed the pilot work of modern apprenticeship [1].The training goal of modern apprenticeship is to complete the comprehensive professional abilities required for "professional typical work tasks" and obtain "work process knowledge" in real work situations. It is different from traditional apprenticeship operation skill training and school education to impart academic knowledge. [3-5] The elements of modern apprenticeship are dual-qualified tutors and a real working environment. The modern apprenticeship system advocates on-site teaching in enterprises.

2.3. "Dual System" Teaching Mode

The "Dual System" also originated in Germany, and is currently recognized as one of the best professional classroom teaching models for cultivating technical talents in the vocational education field. [6-8] With the goal of cultivating students' comprehensive professional ability, it advocates an integrated teaching method of theory and practice, gathering teaching, learning, and doing into one. On the one hand, the integrated teaching method of theory and practice requires dual-qualified teachers; on the other hand, it requires a real on-site production environment. The integration of theory and practice tends to teach in the school training room. The teaching phase of modern apprenticeship tends to be in the factory, and the "dual system" teaching is in the school base. They have the same requirements for teachers and teaching environment. Both are in line with the goal of

"cultivating applied, compound, skilled, and innovative talents" technology application education.

2.4. The apprenticeship system rooted in the development of Chinese culture

The private school teaching of the ancient educator Confucius opened the mode of apprenticeship for talent training. Focusing on "people with mature professional knowledge and skills (masters) lead others (apprentices) into new theoretical or practical fields, this model has greatly promoted the inheritance of Chinese culture and is deeply rooted in the training of professional skills[9]. In the 1950s, the apprenticeship system was the mainstream in the talent training and process inheritance of state-owned enterprises. The company determines the apprenticeship period for new employees in each position according to the technical difficulty of the occupation, and each new employee is led by a full-time qualified worker (master) in the same position to study vocational skills, for example, the apprenticeship of an electrician is three years. This is our traditional apprenticeship system. Its characteristics are that the masters are required to have the theoretical and practical skills of the position; they have a real working environment; and the learning process is long. Because vocational skills need to be exercised in specific practice, some production links may not have practical opportunities for several months.

2.5. The construction of the practice teaching mode of modern mentorship

The common characteristics of the traditional apprenticeship system in China, the dual system of German origin and the modern apprenticeship system are mature vocational skill instructors (teachers), real working environment (places), and various learning links (courses) suitable for all-round training of vocational skills. The traditional apprenticeship system is for a small number of local audiences (usually individuals); the "dual system" teaching requires education departments (schools) to build real workshops, which in practice are usually workshops built in cooperation with enterprises; modern apprenticeships require the actual work site.

In view of the difficulties such as the lack of real working environment and the lack of a real environment for special training for electrical engineers, we start with the development of teachers and taking the double-qualified professor with decades of management and design experience in electrical first-line operation as the leader, the teaching method of simulation teaching, construction of virtual environment and combined with visit internship. A four-year consistent system for educating people for electrical engineers has been formulated, and young teachers are led by professional leaders to construct a modern mentorship teaching model for practical training. Its advantage is that all training links are controllable, all students participating in learning can learn simultaneously, there is no limit to the number of participants, and the process of a teaching topic can be arbitrarily divided and practiced. The practical training process can be repeated and reproduced, personalized teaching can be fully integrated into the teaching process, and the teacher’s guidance to students is more specific.

3. Training and teaching practice under the mode of modern tutorial system

3.1. Construction of a four-year consistent training system

The training content for cultivating the practical work ability of electrical engineers is divided into five categories. They are research and development, design calculation, operation and maintenance, technical management and production management.

Among them, the research and development category designs teaching activities in accordance with the job requirements for the preparation of design and production tasks, such as sci-tech novelty retrieval, reading literature, writing, vertical and horizontal management coordination, and technical coordination with civil engineering, mechanics and hydraulics. The design calculation class is designed according to the ability requirements of the production design department, such as engineering budgeter and power operation technician. Specific to each training course, the course is broken down into training units (projects), and at the same time, the teaching of each project is carried out with five ability training to form specific knowledge points. For example, the course of

"Electrician Skills Practice" is divided into production task preparation, engineering design, engineering budget, material and tool plan preparation, process preparation, filling in the picking list, material preparation, component testing, installation and commissioning, project acceptance, and project final accounts. And implement them step by step; Meanwhile, the education and training on production safety, tool and instrument use, team management and tool and material storage are also ongoing. After training, the knowledge point is assessed for compliance according to the actual job steps.

3.2. Training mode

Research and development knowledge points implement open teaching in which students ask questions and carry out research activities on their own, and form work plans and program requirements under the guidance of the tutor. Design and calculation knowledge points are taught in the design room. The working procedures are: the assignment of design tasks, the composition of the team, the formulation of design indicators, the retrieval of design materials, the learning of design-related knowledge (theoretical teaching), and the implementation of the design.

Operation and maintenance knowledge points are taught in the professional training room.The working procedures are: the basic principles and composition of the device (theoretical teaching), the disassembly and assembly of the device, the maintenance of the device, comprehensive troubleshooting. During this period, knowledge of safety in production and corporate culture education are interspersed. The technical and production management knowledge points are carried out in the design room and the training room respectively. The working procedures are: safety production supervision, role simulation in production management, such as safety clerk, material clerk, tool personnel, engineering quality inspectors, engineering supervisors, inspectors, work team leaders, dispatchers, workshop directors, etc. Interspersed with practical literature writing training during this period including work ticket issuance, business notice, work report, technical summary, and contract documents and so on.

3.3. Training environment

The whole process of practical training and teaching based on the modern tutorial system is completed on the campus of Kashi University. Different from the school-enterprise cooperation and enterprise-oriented thinking in the modern apprenticeship system [1], the design room and training room are constructed by double-qualified teachers according to the real production site. The training environment has achieved an effect that cannot be achieved in a real working environment. It is manifested in five aspects: First, the training process is comprehensive. All the professional skills that an electrical engineer should have are included in the training teaching plan. Second, the training process is gradual as planned, and the skills will be improved step by step in the four-year consistent training. For example, science and technology reading training for the third semester, scientific retrieval training for the fourth semester, and writing training for the fifth semester. The third is the large capacity of the training audience, which can meet the needs of the entire class to participate in the training simultaneously; the insufficient capacity of the training venue is a problem colleges and universities nationwide face currently in the practice teaching, and it also cannot be satisfied at the workplace of enterprises and institutions. Fourth, teaching can be carried out in an orderly manner in accordance with the teaching plan, without being affected by the actual production process on the job site. Fifth, any training session can be repeated and reproduced, which is consistent with the repeated practice concept of traditional teaching and that’s not easy to achieve in the actual work site.

3.4. Teaching team

The modern mentorship teaching mode requires a capable tutor to ensure the training objectives and the tutor must have the ability to demonstrate and teach all knowledge points. This requires a highly qualified tutor with rich practical work experience to undertake. Fortunately, our practice has proved that as long as there is one such leader in a teaching team, this teaching mode can be practiced.

3.5. Effectiveness of training talents

The employment rate of the graduates in last three years as a whole in this major exceeds 80%, and the students have a strong ability to adapt to their positions. For example, in the State Grid Interview Test, both the Minority and Han students got generally high scores, with more than 90% students got scores above 80; In the pre-job technical assessment of the State Grid, all students got recruited have achieved excellent results.

4. Educational Reflection

After six years of curriculum reform, we realize that the primary factor restricting the development of modern mentoring teaching mode in technology application-oriented colleges and universities lies in teachers. That's because it is difficult to cultivate double-qualified teachers with the above-mentioned ability to lead the teaching team. The second key factor is the training room. At present, colleges and universities do not fully have the facilities required for this curriculum reform [1].

The way to improve these restrictive factors is to train teachers to meet the requirements of modern mentorship teaching. And what colleges and universities need to do now is to hire corporate experts to teach the practice part on the one hand, and on the other hand to increase the intensity of teachers to participate in the practice in the enterprise [1].As far as the national policy is concerned, the first is to establish a school-enterprise talent sharing mechanism to create more double-qualified teachers to serve the training of skilled talents; The second is to introduce an active policy to encourage enterprises to participate in the training, so as to avoid the current phenomenon of colleges and universities one-sided enthusiasm in the school-enterprise talent training cooperation. In terms of equipment, it is necessary to increase investment in colleges and universities transforming to application-oriented ones.

The simulated real environment adopted in this curriculum reform is an effective method. At present, "School in Factories" is still far from the demand for application-oriented talent training; and the implementation of "Factory in School" is more in line with realistic conditions [1]. We are implementing the construction of a factory in our campus, and we have also tried the cooperation of "school-research-government-enterprise".

Application-oriented engineering colleges and universities should take the road of cooperative education, breaking the boundaries of schools, majors, courses, classrooms, and teachers. and form a new type of training model of resource co-construction, full participation, mutual benefit and win-win, based on the interests of governments, universities, enterprises, scientific research institutions and other subsystems of society demand. Cooperative education mechanism is the key way for the development of such universities [1,10]. The teaching of technical application-oriented engineering training courses has high requirements for the comprehensive quality of teachers; the training environment is required to be real, repeatable, and synchronized by multiple people. This requires in-depth and solid production, learning, research, and government close quarters. The construction of the modern mentorship training teaching system provides a new paradigm for practical teaching in engineering and technology application-oriented colleges and universities.

Acknowledgements

Thank the comprehensive teaching reform project "Research and practice on the training mode of applied talents majoring in Electrical Engineering and Automation—Taking Kashi University as an Example" for the research funding support numbered 2017JG022 approved by the Xinjiang Uygur Autonomous Region Normal College Teaching Reform Research Project.

References

[1] Dayong Huo, Mingxia Ding: The Teaching Practice Based on Modern Apprenticeship with integration of Theory and Practice Teaching Mode [J],Advances in Intelligent Systems Research,

2016 (129):1003-1007.

[2] Y. Yang: Modern apprenticeship training high-end manufacturing industry in urgent need of talents [N], China Education Daily, Beijing, 2014.12.17.

[3] Lina YAN; Research on modern apprenticeship in Switzerland [D].Northeast Petroleum University, 2019.

[4] Kaixuan SONG; Research on the reform of American Modern Apprenticeship [D]. Hebei Normal University, 2020.

[5] Yanyan GUO：Research on the cultivation of modern apprenticeship talents [D]. Tianjin University,2017.

[6] Huiting CAO: Research on school enterprise cooperation of Higher Vocational Education Based on German "dual system" [D]. Qinghai Normal University, 2017.

[7] Hongfeng LIU: Research on the implementation strategy of dual system vocational education system in China [D]. Tianjin University, 2016.

[8] Dong CHENG: Research on the adaptation of German "dual system" national teaching standards to social and Technological Development [D]. Tianjin University,2018.

[9] Weijie LIU: Enlightenment of Confucius' Educational Thought on Contemporary Physical Education [D]. Taiyuan University of Technology, 2016.

[10] Xiaohui SUN: Research on the path of training applied talents by integration of production and education in Local Engineering Colleges [D].Harbin University of Science and Technology,2017.