Construction and Practice of Innovative Practice Teaching System Based on OBE

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Abstract: This paper focuses on the training goal and orientation of high-level applied talents with innovative spirit and practical ability. According to the requirements of personnel training in the new era, the overall goal of practical teaching based on output orientation is established in accordance with the "nine principles". The project team system constructs a practical teaching system of "three levels, four breakthroughs and five combinations". It meets the practical teaching needs of different majors and levels, and strengthens the cultivation of students' innovative spirit and practical ability through various channels and levels. Through improving the comprehensive evaluation system of students and scientific management of innovation and entrepreneurship laboratory, students' innovative spirit and practical ability have been improved significantly. The number of students participating in innovative entrepreneurship projects and competitions is increasing year by year. The reform of this achievement has achieved remarkable results and has the value of demonstration and promotion.

1. Introduction

OBE (Outcome-Based Education) is defined as "clearly focusing and organizing the education system around the experience of ensuring substantial success in students'future lives". Emphasis is placed on the following points: teaching objectives: "What are the learning outcomes that students want to achieve?" The social demand "Why should students get such learning results?" The teaching process "How to effectively help students achieve these learning outcomes?" How do you know that students have achieved these results? And continuous improvement "How to ensure that students can achieve these learning outcomes?" These five aspects. Through investigation and literature review, the main achievements of introducing OBE concept into practical teaching system in China are research universities, such as Wuhan University and South China University of Technology, etc. Moreover, single curriculum and single practice link research are mostly lack of systematization, their research conclusions are single, lack of support for practical application, and lack of supporting system guarantee and specific measures. Constructing practical teaching system based on the concept of OBE is a very complex system engineering. It not only needs to design a comprehensive system from the aspects of social needs, school-running orientation, training objectives, training plans, curriculum settings, curriculum outline, teaching process, teaching monitoring, quality evaluation and continuous improvement, but also needs to be improved. The key is that the system design should first go deep into every teacher's teaching idea, into every practical teaching link, and into the whole process of each student's growth and maturity. The system design also needs to reform the system and mechanism in the aspects of teaching guarantee, management system, assessment and evaluation, and provide guarantee and guidance from the aspects of policy system and benefit distribution.

This research mainly analyses the main problems existing in the current applied practical teaching system and mode through the methods of problem investigation, literature research, comparative study and practice while researching. Taking the four majors of Physics and Telecommunication

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Engineering College of Shaanxi University of Technology as experimental majors, this paper summarizes the concrete measures and methods of reform, including the revised version. Students'training plan, optimization of training program, syllabus, improvement of teaching methods and establishment of evaluation system, etc.

2. Establishing and Practicing the Training Idea and Target of Applied Innovative Talents

Following the guiding ideology of Shaanxi University of Science and Technology, we aim at the characteristics of local colleges and universities, and combine the training objectives and social needs of our specialty. Through exploration and practice, we gradually form the concept of "serving the front line, highlighting personality, strengthening innovation" and application-oriented training of innovative talents. We have set the goal of training applied innovative talents to improve students'engineering application ability, practical innovation ability, communication and cooperation ability. Undergraduates'basic knowledge, basic skills and basic qualities are the core, and lifelong learning ability is also the key. Only by focusing on training practical ability, highlighting innovation and entrepreneurship education, and improving students' employment competitiveness, can local undergraduate colleges and universities find a basic way out.

In the process of practice teaching and practical ability training, the overall goal of practice teaching based on output orientation is established in accordance with the "Nine Principles", namely "interest orientation, scientific rigor, hands-on practice; problem orientation, questioning thinking, comprehensive application; innovation as the soul, learning for application, growth as the foundation". In practice teaching, we always focus on the four links of undergraduate professional learning, project research and development, theoretical learning and practical training. In the process of teaching, we should properly compress the teaching hours of theoretical teaching, increase the time of practical teaching, stimulate students'interest by solving practical engineering problems (or simulating solving engineering problems), enhance students' self-confidence and autonomy in learning, improve their comprehensive quality, cultivate innovative spirit and stimulate their personality development.

3. Construction and Practice of Innovative Practice Teaching System based on OBE

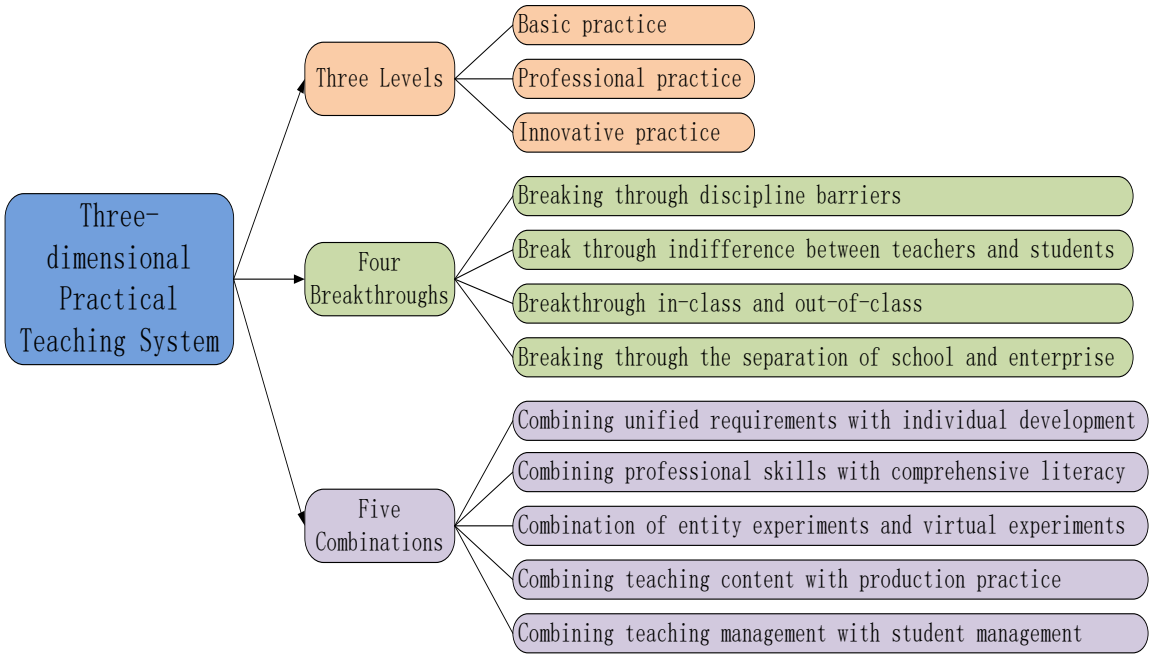

Figure 1. The training objectives of the practical teaching system of "Three Levels, Four Breakthroughs and Five Combinations"

Shaanxi University of Technology now has 17 colleges and 2 teaching and experimental training

centers, 65 undergraduate majors. We regard four undergraduate majors in the College of Physics and Telecommunications Engineering as pilot majors of innovative practical teaching system, namely, electronic information engineering, electronic information science and technology, communication engineering and physics.The training objectives of the practical teaching system of "three levels, four breakthroughs and five combinations" are systematically constructed. As shown in Figure 1 below, it includes three levels: basic practice, professional practice and innovative practice. This system has achieved "four breakthroughs", that is, breaking through disciplinary barriers, breaking through indifference between teachers and students, breaking through in-class and out-of-class, breaking through the separation of schools and enterprises. This system realizes "five combinations", that is, the combination of unified requirements and personality development, the combination of professional skills and comprehensive literacy training, the combination of entity experiment and virtual experiment, the combination of teaching content and production practice, and the combination of teaching management and student management.

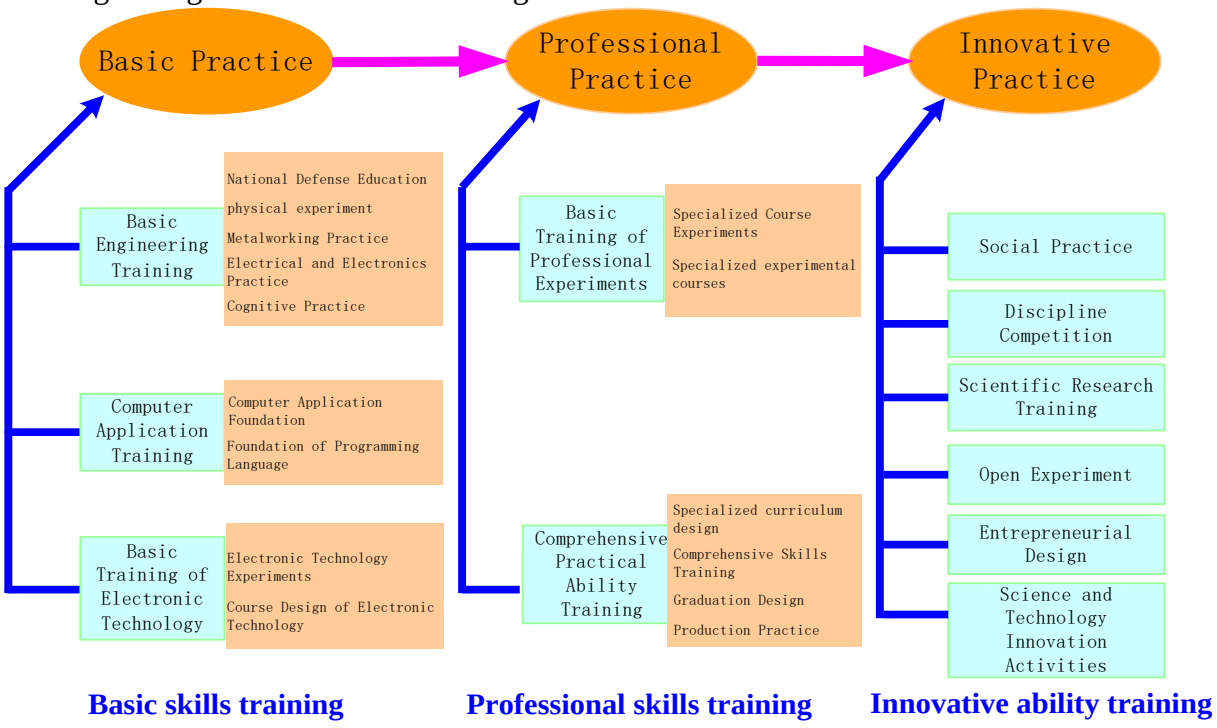

Figure 2. Innovative practice teaching system

We pay attention to the comprehensive cultivation of students'knowledge, ability and quality, take the cultivation of professional technology application ability as the main line, earnestly sum up years of teaching experience, in view of the existing problems in practice, strengthen the basic skills of undergraduates, comprehensive application ability and practical engineering application ability. Through close integration with theoretical teaching, strengthening basic skills training and professional skills training, highlighting the cultivation of innovative spirit and practical ability, the innovative practical teaching system is constructed as shown in Figure 2.In the three levels of basic practice, professional practice and innovative practice, basic practice consists of three modules: basic engineering training, computer application training and basic electronic technology training. The basic engineering training includes five links: national defense education, physical experiment, metalworking practice, electrical and electronic practice and cognitive practice, and computer application. There are two links in the training: computer application foundation and programming language foundation. The basic training of electronic technology includes two links: electronic technology experiment and electronic technology curriculum design. Professional practice consists of two modules: professional experimental basic training and comprehensive practical ability training. Among them, professional experimental basic training has two links: professional course experiment and professional experimental course, and comprehensive practical ability training has four links:

professional course design, comprehensive skills training, graduation design and production practice. Innovation practice includes six modules: social practice, discipline competition, scientific research training, open experiment, entrepreneurship design and scientific and technological innovation activities. Basic practice focuses on cultivating students'rigorous scientific attitude, basic skills and innovative consciousness; professional practice is to cultivate students' ability to discover, analyze and solve problems and innovative spirit; innovative practice is to cultivate students'innovative ability and entrepreneurial skills. The three levels are from basic skills training to professional skills training, and then to innovative ability training. By doing so step by step, cross-penetration, mutual independence and cohesion, the four-year continuous line of professional practice teaching has been realized.

3.1 Formulate and Revise Training Plan According to Industrial Structure and Market Adjustment.

The college of physics and telecommunications engineering attaches great importance to the formulation and revision of personnel training programs. It makes minor revisions every four years. The formulation of the training plan closely revolves around the training objectives of various majors, adheres to the combination of knowledge, ability and quality, adheres to the combination of unified requirements and personality development, adheres to the combination of professional skills and comprehensive literacy training, adheres to the combination of teaching content and production practice, takes "output" as the guidance, emphasizes the foundation and broadens the specialty. To enhance the social adaptability of graduates, the latest training program of the 2018 edition has been formed. Professional training plan must be forward-looking. The construction of each specialty in the college of physics and telecommunications engineering is supervised by the college's teaching steering committee: from the needs investigation of enterprises and institutions, the formulation of talent training plan, specialty construction, the formulation of teaching syllabus, the determination of teaching content and curriculum system to the specific implementation. Every year, we organize some professional teachers to conduct research in enterprises, and feedback information of employers and graduates (graduates'work tasks, work process, work ability requirements and job competency, etc.). We make analysis and demonstration, then determine the quantity and quality of talents according to the change of market demand for talents, determine the training objectives of professional talents according to the change of post knowledge, skills and attitudes, and revise the training plan in time by the college teaching steering committee to implement it in time.

3.2 Integration of Disciplines, Complementarity of Multi-specialties, Optimizing Practice Links.

The college of physics and telecommunications engineering has four undergraduate majors: Physics (Normal), Communication Engineering, Electronic Information Science and Technology, and Electronic Information Engineering. According to the characteristics of the college, we integrate disciplines, complement the specialties of science and engineering, break the curriculum discipline structure, rationally determine the teaching content and set up practical links according to the requirements of students'ability training, take into account the needs of specialty and sustainable development, and add new courses and new technologies. We have formulated practical teaching contents and syllabuses which include knowledge, ability and quality. In teaching, we have not only the goal of imparting knowledge, but also the goal of cultivating ability and quality. We have also formulated the content and syllabus of assessment which include knowledge, ability and quality, so as to assess not only the mastery of knowledge, but also the skills. The assessment also includes the assessment of quality, which integrates theory, practice and quality.In many courses, the characteristics of practical courses have been formed, which are centered on the cultivation of students'innovative ability and driven by works and projects.Examination also adopts flexible and diverse forms of assessment: written examination (open-book, closed-paper), operation, reply and other forms of assessment, the experimental course mostly replaces theoretical examination with operation, mainly examines experimental skills and operational skills, or the combination of

theoretical examination and operation, the classification of theoretical and operational results and other performance evaluation forms.

3.3 Standardize the Management System of Practical Teaching, Promote Training by Competition, Promote Teaching by Competition, Promote Learning by Competition and Promote Research by Competition.

According to the normative documents such as "Regulations on the Work of Experimental Teaching Center", "Graduation Thesis (Design) Quality Evaluation System" and "Management Measures for Graduation Thesis Design" formulated by the school, the teaching links such as experiment, training, curriculum design, production practice, social practice and graduation design are clearly stipulated and required. And improve the practice teaching system. We require experimental teaching to adhere to the system of pre-class preparation experiment and after-class review experiment to ensure that students really grasp the experiment; we require practical training and production practice to adhere to "organized, planned, mobilized, process, monitored and summarized", to ensure that it is carried out in a planned and step-by-step manner. We have made clear the norms and requirements of the graduation design link, monitored the quality of the completion of the graduation design, strictly enforced the relevant regulations of topic selection and question opening, ensured the quality of topic selection and question opening, strictly enforced the relevant regulations of examination, review and reply, strictly controlled the late reply, strengthened the process monitoring, and strictly enforced the process inspection and supervision. Leaders insist on participating in the process of opening questions, mid-term examination and graduation defense, and put forward corrective suggestions when problems are found.

The college attaches great importance to students'extracurricular technological innovation activities and social practice activities. It has built three innovative laboratories for college students and constructed a multi-level extracurricular innovative ability training system, as shown in Figure 3 below. After many years of practice, we have explored the effective mode and mechanism of the operation of our innovative laboratory. Students can enter the laboratory early in their freshmen or sophomores, and play an important role in cultivating students'innovative spirit and practical ability. competition activities are managed by project. Students'associations of academic science and technology and practice have become carriers of students' scientific and technological innovation and social practice activities, and are responsible for carrying out daily activities.

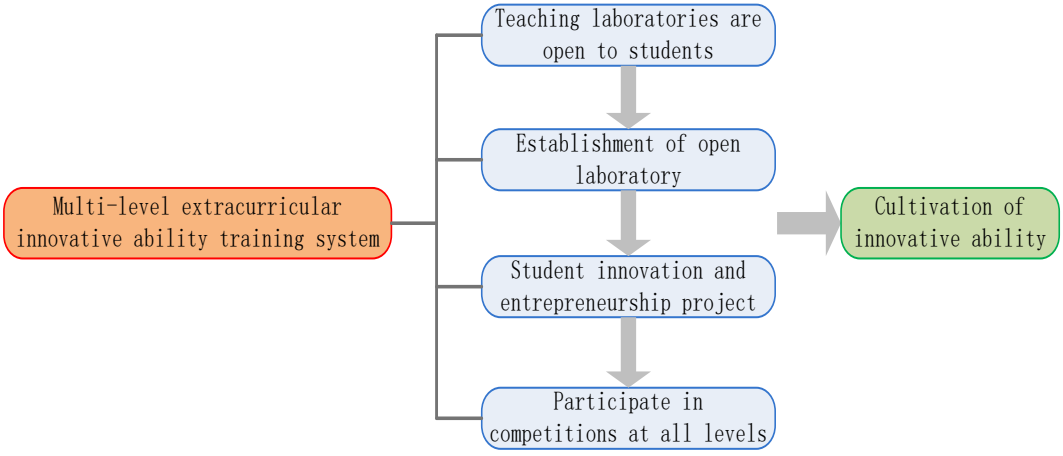

Figure 3. Multi-level extracurricular innovative ability training system

3.4 Laboratories are Open to Students in an All-Round Way, with a Wide Range, a Long Time and Good Results.

The College actively promotes the opening of laboratories to students, and formulates management measures for opening laboratories. The laboratories are open in a wide range, for a long time, with a large coverage and good results. The open forms mainly include six types: experimental courses, students'participation in scientific research, students' scientific and technological activities,

students'optional experimental topics, intercollegiate exchanges and social services. The experimental curriculum is mainly designed by students themselves. When they encounter difficulties, they consult and answer questions from senior students or teachers. Student participation in scientific research is based on teachers'research fields or scientific research projects to issue open research topics regularly, attracting some students to enter the laboratory to participate in scientific research. Student science and technology activities are based on the needs of participating in subject competitions or University Students'extracurricular science and technology activities, combined with laboratory equipment and other equipment, according to different events to develop their own topics, carry out experimental research. The optional experimental project type mainly encourages college students to complete innovative design experiments by themselves, including scheme design, experimental device and debugging, and writing experimental reports. Inter-school communication is the exchange of teaching, scientific research and guidance for students with related brotherly colleges and universities. Social service type is that laboratories make full use of equipment and technology to serve the society or open training.

3.5 Following the CDIO Teaching Concept and Integrating Various Teaching Methods.

We attach great importance to the reform of traditional teaching methods and means, adhere to the "CDIO" engineering education model, take "learning by doing" as the guide in practical teaching, and integrate heuristic, discovery, teaching, demonstration, visiting, practice, discussion and inquiry teaching methods. In the reform of textbooks, practical engineering design cases and practical production cases are introduced. In the practical teaching system, each important knowledge point is combined with practical application. Team learning mode and innovative thinking are integrated into teaching, and students are guided to study spontaneously and think independently. Students learn by doing and complete the teaching process in accordance with the five links of project proposal, project learning, project realization, project evaluation and project expansion.

3.6 Developing Virtual Experiments, Standardizing Design and Comprehensive Experiments, and Promoting Students'interest.

We take circuit analysis, analog circuit, digital circuit, high-frequency circuit and other electronic technology comprehensive experimental projects as teaching content, and add appropriate content of specialized applied technology courses (program design, single chip computer, programmable control technology, digital signal processing, etc.) to form a single goal, a variety of programs, students'independent design. Teachers focus on designing, comprehensive and innovative experiments to train students'ability to use knowledge comprehensively and to design and innovate independently. The experimental design, innovation requirements and experimental objectives were formulated. For different experiments, the experimental forms are first made according to the requirements of designing and innovative experiments, and then the relevant teachers and senior students are organized to discuss and seek opinions to determine its feasibility and effectiveness, and then formalized and published for implementation. To formulate design, comprehensive and innovative experimental norms to ensure the quality of experimental teaching in a systematic way. With the help of simulation and virtual reality technology instead of traditional experiment operation, college teachers have compiled electronic technology virtual experiment project library in EDA tool software such as Multisim and proteus, which includes circuit analysis, digital circuit and analog circuit. There are demonstration experiment and simulation experiment respectively, which have been applied in practice. In the experiment teaching and examination, students can learn in the laboratory and on the network at the same time, and have achieved good results.

3.7 Developing Teaching Websites with Abundant Pictures and Texts to Promote Students'autonomous Learning.

The College of Physics and Telecommunications Engineering has established a learning platform for practical teaching courses on campus network, optimized the network learning resource bank and realized resource sharing. Using the network to provide students with a large number of relevant

teaching materials, such as courseware, electronic teaching plans, textbooks, experimental syllabus, experimental guidance, simulation software, simulation experiment database, exercise database, test database, etc., to facilitate students'autonomous learning in the network. The most distinctive feature of the platform is that teachers can recruit students to join their own scientific research projects in real time through the "student training" module, and then use QQ group to set up a professional discussion forum to discuss learning problems in the group.

3.8 To Infiltrate Engineering Application and Teachers'scientific Research into Graduation Design, Strengthen Process Management, and Attach Importance to the Examination of Students' Engineering Literacy.

The "Graduation Design Management Measures" formulated by the College clearly requires that the graduation design should be based on students'works and supplemented by papers. Students'works come from teaching, production or scientific research and meet the requirements of professional training objectives. Graduation design carries out the principle of three combinations to select topics: (1) combining with production practice; (2) combining with campus practice platform; (3) combining with teachers. Graduation design management system runs through the whole process of graduation design implementation, including the issuance of documents and notifications, the upload and download of forms, subject declaration and review, topic confirmation, submission and process control of opening report, submission and process control of papers, distribution of evaluation and defense teachers, process control of review and defense, and defense process. Control, grading of papers at various stages, summary and modification of achievements, spot checking and evaluation, printing of documents and materials, archiving and inquiring of historical records, all of which achieve networked management, strengthen process quality management, break the limitations of time and space, facilitate teachers and students, and improve efficiency.

3.9 Integrating Innovation and Entrepreneurship Education into the Whole Process of Personnel Training and Promoting the Construction of Pilot Colleges for Innovation and Entrepreneurship Education.

In 2016, physics and telecommunications engineering college was approved as the first batch of pilot colleges of innovative entrepreneurship education. The implementation plan has been constantly revised and perfected. The overall goal of the construction of pilot colleges of innovative entrepreneurship education is to adhere to the guiding ideology of facing all, classifying teaching, combining specialties, strengthening practice and promoting students'all-round development. To realize the basic course of innovation and entrepreneurship for all students, to carry out various forms of innovation and entrepreneurship education practice activities, and to integrate innovation and entrepreneurship education into all aspects of the basic requirements of college personnel training. We should build an innovation and entrepreneurship education characteristic system for all students, students with entrepreneurial intention, and students with initial entrepreneurial experience.

3.10 Establishment of Network Layered Practice Teaching Management and Quality Evaluation System based on PDCA Cycle.

The network information management of practical teaching is the best way to solve the problems of complicated management of practical teaching, difficult control of teaching process, difficult monitoring of teaching quality, reducing management cost and improving management efficiency. Shaanxi University of Science and Technology has systematically established a network information management system for practical teaching, including laboratory management system, experimental teaching quality evaluation system, graduation thesis (design) management system, subject competition management system, practice training management system and college students'innovation and entrepreneurship training plan management system.Many factors determine that the quality management of experimental teaching is a process that needs continuous improvement. The greatest advantage of PDCA mode is that it can promote the continuous improvement of quality. It has been applied to the practice of experimental teaching quality

management in our university. PDCA consists of four processes: planning, execution, inspection and continuous improvement. Through the development of the next and subsequent PDCA cycles, the quality of practical teaching management will spiral upward and be continuously improved, so that it can really play a role in ensuring the quality of experimental teaching in our university.

4. Summary

Through research and practice, the cultivation of students'innovative spirit and practical ability has been promoted in an all-round and multi-faceted way. The students' innovative spirit and practical ability have been greatly improved, and the reform has achieved remarkable results. The reform and construction of practical teaching mode and management and guarantee mechanism of achievements have been highly praised and widely used for reference by brothers'colleges and universities. Shanghai Second Polytechnic University, Xiangfan University, Yan'an University, Baoji College of Arts and Sciences, Weinan Normal University, Xianyang Normal College, Ankang College, Yulin College, Shangluo College and other provincial and foreign brothers'colleges visited and exchanged their experience in the practical teaching of our college, and brothers' colleges conducted theoretical research and exchanges with us. Specific practices are highly appreciated, and can be used for reference in its personnel training program and practical teaching. Based on the research and practice of the output-oriented applied practical teaching system, the educational ideas and practical teaching modes have been fully absorbed in the revision of the training plan for the 2018 edition of the discipline, and the innovative practical teaching has been strengthened and systematized, which runs through the teaching concepts, training modes and operating mechanisms. It has become one of the two wings of the practical teaching system.

Acknowledgements

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References

[1] Song Xinquan, Zhang Weijie. Difficulties and Solutions of Fair Funding in Colleges and Universities from the Perspective of OBE Education [J]. China Adult Education, 2017 (01): 72-76.

[2] Jiang Yunhao, Ding Wenfang, Gong Li, Chen Jun, Chen Hui and Wang Sheng. On Discussive Teaching under the Background of Engineering Education Professional Certification [J]. Education and Teaching Forum, 2017 (15): 182-184.

[3] Wang Weifang. Analysis of Teachers'Subjective Value under the Results-oriented Education Paradigm [J]. University Education, 2017 (08): 169-171.

[4] Shen Li, Liu Yanjuan, Luo Shengtai. Research on the construction of core curriculum group of Environmental Engineering Specialty Based on OBE concept: Take the construction of core curriculum group of environmental engineering specialty of Tangshan University as an example [J]. Green Science and Technology, 2018 (11): 276-277.

[5] Zhao Tingting, Wu Leilei, Fan Wenqiang. An analysis of the correlation between undergraduate subject settings and Employment-an online survey of undergraduate graduates [J]. Education Research of Tsinghua University, 2005 (01): 97-103.

[6] Zhang Yiming, Zhang Qinwen. Ways to realize the cultivation of Applied Innovative Talents in local colleges and universities: based on the reform practice of "502 innovative experimental teaching mode" of Shaanxi Institute of Technology [J]. Learning theory, 2012 (30): 176-178.

[7] Zhang Yiming. Insert wings of scientific innovation for students [N]. China Education Daily, 2011-12-19 (003).

[8] Lu Guodong. Five Breakthroughs and Preliminary Explorations in the Construction of New Subjects [J]. Teaching in Chinese Universities, 2017 (05): 38-41.