Research on Practice Teaching Reform of University-Enterprise Collaborative Cultivation of Engineering Innovation Talents Based on the Concept of OBE

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Abstract: Engineering innovation is an industry requirement in the context of intelligent manufacturing, and it is an important entry point and breakthrough point for the Made in China 2025 strategy. With the transformation and upgrading of China's manufacturing industry towards intelligent manufacturing, there is a strong demand for talents in the field of engineering innovation. However, there are still problems such as knowledge structure defects and weak hands-on abilities in the training of engineering innovation talents in universities. The key to solving this problem lies in strengthening the collaborative training of engineering innovative talents by enterprises and universities, and practical courses in universities are the best way to improve students' engineering innovation ability. Therefore, in response to the above issues, based on the OBE concept, a "trinity" practical teaching model including "theoretical courses, practical courses, and enterprise training" has been constructed. This model is reformed from three aspects: curriculum system and teaching methods, teaching team building, and student evaluation system, aiming to cultivate high-quality and high potential talents with strong practical skills and innovative spirit, and meet the demand for engineering innovation professionals in intelligent manufacturing.

Keywords: OBE Concept; School Enterprise Collaboration; Engineering Innovation Talents; Practical Teaching;

1. Introduction

With the transformation and upgrading of China's manufacturing industry to intelligent manufacturing, there is a strong demand for talents in the field of engineering innovation, but there are still problems such as deficiencies in the knowledge structure and weak hands-on ability in the cultivation of engineering innovation talents in colleges and universities [1]. In view of the above problems, this paper puts forward the implementation path of practical teaching reform based on the concept of OBE (Outcomes-based Education) for university-enterprise collaborative engineering innovation talents:

First of all, the design of school-enterprise collaborative curriculum system is the fundamental guarantee, to build a practice-oriented curriculum system, to strengthen students' practical ability and innovative thinking ability training.

Secondly, the school-enterprise cooperative teaching team construction is the key link, focusing on teachers' practical experience and industry background to improve the teaching ability and innovation ability of the teaching team.

Finally, school-enterprise cooperative student evaluation system is a guarantee, the evaluation content includes the cultivation of students' comprehensive quality and ability, and the improvement of practical ability and innovation ability.

Through the practical teaching reform of school-enterprise collaborative engineering innovation talent training based on the OBE concept, it is of great theoretical and practical significance to improve the cultivation level of engineering innovation talents in colleges and universities and to meet the social demand for engineering innovation talents.

2. Problems Facing Engineering Innovation Talent Cultivation in Universities

In the existing engineering talent training model, colleges are usually independently

responsible for curriculum design and teaching management, and the connection between engineering practice and the industry is relatively weak. This model has led to many problems in the cultivation of engineering innovation talents in universities.

2.1 Incomplete Curriculum System and single Way of Training Students

There are some problems in the traditional practical course curriculum mode, such as the lack of relevance, lagging teaching content, and the inability to completely cover the whole process of engineering personnel training, without forming a complete closed loop [2]. Pure theory teaching and classroom practical training teaching can not keep up with the requirements of the times, and can not meet the new era requirements of modern advanced intelligent manufacturing on students' skills. In addition, the current training method of students is relatively single, which can not effectively stimulate the innovative potential and creativity of students. Most colleges and universities still use the traditional education model of teacher instruction and passive student learning, resulting in a lack of initiative and innovative thinking ability of students [3].

2.2 Unstructured Teacher Teams

In the field of engineering innovation, which involves a large number of disciplines and rapid technological updates, there is a need for complex teachers with broad and in-depth professional knowledge as well as high-level operational skills [4]. In the occupational category belongs to both engineering technology and education, in the knowledge structure requires both in-depth and comprehensive professional theoretical knowledge, but also requires proficient practical skills and understanding of the actual requirements of manufacturing enterprises. Most of the teachers of practical teaching come from general engineering colleges, there are problems of overlapping disciplines and insufficiently balanced distribution of specialties, and the teachers are more solid in theoretical knowledge and lack of engineering and technical literacy, and there is a general problem of focusing on theories and light on practical exercises, which can't satisfy the comprehensive requirements of the cultivation of composite talents [5]. Secondly, there are differences in the academic level and teaching ability of teachers. Some teachers are mainly oriented to scientific research ability and lack effective teaching methods and means in practical teaching; while others may lack scientific research results, resulting in the teaching content not being able to keep pace with the development of industrial frontiers [6]. This difference between individual teachers will affect the teaching quality of the overall teacher team and the learning effect of students, resulting in students not being able to adapt to the requirements of enterprises for intelligent manufacturing talents, and not being able to meet the needs of the era of transformation and upgrading of China's manufacturing industry.

2.3 Incomplete Student Evaluation System

The incompleteness of the student evaluation system is an important problem facing the cultivation of engineering innovation talents in colleges and universities. The current student evaluation system is mainly centered on test scores and credit grades, and is obviously insufficient in evaluating students' practical and innovative abilities[7]. This type of evaluation relies too much on students' memorization and test-taking ability, and only completes the corresponding content according to the teaching arrangement, which cannot comprehensively and objectively reflect students' real level and potential. There is a need to build a more scientific, comprehensive and targeted evaluation system that takes full account of students' individual strengths and development needs, and should focus on the assessment of students' innovative and practical abilities, and on the evaluation of students' personality development and quality cultivation.

3. The Significance of University-enterprise Collaborative Engineering Innovation Talent Cultivation under the Concept of OBE

The university-enterprise collaborative engineering innovation talent cultivation model based on the OBE concept aims to

build a new learning mode, which is oriented to students' learning outcomes and focuses on the cultivation of students' practical abilities[8]. This model breaks the traditional disciplinary boundaries, and is of great significance for cultivating talents who can adapt to the needs of engineering innovation.

First of all, the OBE concept focuses on ability cultivation and can improve students' practical and innovation ability. university-enterprise collaboration can provide richer practical opportunities for students to practice projects in real work environments, so as to cultivate their ability to solve practical problems and innovative thinking [9].

Secondly, university-enterprise collaborative engineering innovation talent cultivation can strengthen university-industry cooperation and make education more compatible with industrial needs. Through close cooperation with enterprises, schools can gain a deeper understanding of industrial development trends and needs, and integrate this information into the curriculum and teaching practice, so that the content learned by students is closer to the actual work needs [10].

Finally, university-enterprise collaborative engineering innovation talent cultivation can promote the construction of teachers. Teachers can cooperate with enterprise professionals in the design and implementation of projects, from which they can gain practical experience and the latest information of the industry. This will help teachers improve their own teaching level and professionalism and provide better teaching quality and guidance [11].

4. Implementation Path of Practical Teaching for Innovative Talents in University Enterprise Collaborative Engineering based on OBE Concept

This paper takes China JiLiang University and Hexagon Manufacturing Intelligent Technology (Qingdao) Co., Ltd. as an example of university-enterprise cooperation, and researches and explores the "Trinity" university-enterprise collaborative cultivation mode of engineering innovation talents based on practical teaching. The whole-process course system design for engineering practice, the establishment of a scientific teaching team and evaluation system, and the integration of teaching resources inside and outside the classroom are carried out to improve the model of collaborative cultivation of engineering innovation talents between universities and enterprises, as shown in Figure 1.

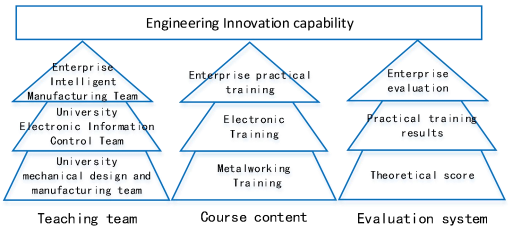

Figure 1 "Trinity" University-enterprise Collaborative Training Practice Teaching Mode

4.1 Design of University-Enterprise Collaborative Curriculum System

The design of the curriculum is based on the output-oriented OBE principle, breaking the disciplinary and professional boundaries, automation, mechanical design, measurement and control of the latest technology, cross-fertilization in the curriculum system of engineering innovation personnel training, and reverse setting of the curriculum system with the intelligent detection and manufacturing technology system. To build a complete closed-loop system of intelligent inspection technology, based on the real inspection case projects of enterprises, and with the three core criteria of "student-centered, output-oriented, and continuous improvement", the specific curriculum system is shown in Table 1.

Metalwork practical training is the first level, mainly for students to understand and master the basic ability of mechanical design and manufacturing, is the starting point of students' engineering innovation ability, is the foundation of intelligent manufacturing, and lays a solid foundation for subsequent learning.

Electronic practical training is the second level, which is on the basis of mechanical manufacturing, allowing students to understand the operating principles of equipment, improve programming ability, and learn about new technologies and processes, and cultivate students' ability to analyze and solve problems, so as to improve students' engineering practice ability.

Enterprise practical training is the third level, which takes the enterprise real testing case project as the entry point and introduces the modern industrial measurement and

intelligent manufacturing related technology. Through the enterprise practical training, students become compound technical applied talents with the ability to comprehensively use multidisciplinary knowledge, engineering science and technology and modern tools to solve complex engineering problems. The above systematic three-level design of teaching content reflects the teaching objectives of the integrated school-enterprise collaborative curriculum system.

Table 1. Content of University Enterprise Collaborative Curriculum System

Project	Target	Content	Time
Metalworking Training	Students will be able to understand and master the basic ability of mechanical design and manufacturing, learn the basic knowledge of metal material processing, have a preliminary understanding of the operation of modern industrial production, and in the production practice, establish engineering awareness and improve engineering quality.	1. Turning processing 2. Fitter processing 3. Welding forming 4. Milling and grinding processing 5. Casting forming 6. CNC machining	3 weeks
Electronic Training	Enable students to initially master the basic skills of control logic, detection methods, debugging, and development of equipment, instruments, and circuits. Have the ability to analyze the operating principles of equipment, hands-on operation, and programming skills.	1. Component identification and testing 2. Practical training on manual welding skills 3. Electronic Instrument Operation Training 4. Project based practical training	2 weeks
Enterprise practical training	To enable students to acquire a complete knowledge structure and extensive practical engineering experience in industrial product quality inspection technology. Acquire the ability of innovation, research and independent migration of knowledge to solve complex engineering problems. To have the foundation of senior technical talents engaged in industrial product quality testing and analysis, metrology testing and equipment monitoring, quality big data statistics and process control.	1. ASME/ISO geometric tolerances 2. Three coordinate measurement 3. METUS image measurement 4. MSA measurement system analysis	1 weeks

4.2 University-Enterprise Collaborative Teaching Team Building

The Engineering Training Center of China JiLiang University and Hexagon Manufacturing Intelligent Technology (Qingdao) Co., Ltd. have set up a university-enterprise collaborative teaching team consisting of experts and senior technicians with rich engineering experience. Through the form of school enterprise cooperation, a practical training base combining virtual and real, and combining theory and reality has been built, which can provide students with the practical training scenes and virtual simulation scenes needed for practical teaching. Enable university to keep up with the forefront of engineering applications of precision testing technology in terms of knowledge (technology) configuration, and enable students to understand the connection and cross relationship between various knowledge and technologies, avoiding curriculum and knowledge isolation, forming a correct knowledge organization structure, and bridging the "last mile" of professional education and employment needs.

In terms of teaching team building, strengthening the professional competence of the teaching team is crucial. Universities and enterprises can share their respective advantageous resources in the teaching process, promote the participation of university teachers in enterprise professional training, and encourage enterprise engineers to participate in academic exchanges, fully utilize the professional abilities and practical experience of both parties, enhance the professional literacy of teaching team members, and provide comprehensive and practical teaching content for students. Then, the teaching team can improve the teaching content and innovate practical teaching

methods. Universities can incorporate cutting-edge technological developments and new theoretical knowledge into practical teaching. Enterprises can provide more practical teaching cases and projects, allowing students to learn and apply the knowledge they have learned in practice.

4.3 University-Enterprise Collaborative Student Evaluation System

In the practical teaching reform of university-enterprise collaborative engineering innovation talent cultivation based on the OBE concept, the construction of a perfect student evaluation system is an important guarantee mechanism for realizing the training objectives. The collaborative student evaluation system of China JiLiang University and Hexagon, as shown in Table 2, aims to comprehensively and objectively assess the learning outcomes and ability development of students, provide effective feedback and guidance for students, and also provide a basis for teachers and schools to assess the quality of teaching and cultivation effects.

Table 2. University-Enterprise Collaboration Student Evaluation System

Project	Assessment content	Assessment Methods	Percentage of total grade
Metalworking Training	Process assessment	Students are graded based on a combination of product quality, labor attitude, organization and discipline, operational skills and safety practices in completing the internship.	30%
	Project completion assessment	Theoretical examination results Practical training report grade Physical production assessment	70%
Electronic Training	Process assessment	Learning Attitude, Online Teaching Attendance, Attendance, Teamwork	30%
	Project completion assessment	Theoretical examination results Practical training report grade Physical production assessment	70%
Enterprise practical training	Process assessment	Project Training Discipline Project Discussion Presentation Project Training Summary Effect of Project Exercise	30%
	Project completion assessment	According to the questions issued by the enterprise, practically operate the relevant instruments and equipment, complete the relevant operation requirements, and issue the test report. Pass the enterprise training theory examination and assessment, and obtain the certificate of completion.	40%
	Enterprise Mentor Assessment	A holistic approach that takes into account the student's ability to learn, collaborate, get their hands dirty, and work ethic to make an honest assessment.	30%

5. Conclusion

This paper mainly analyzes the problems facing the cultivation of engineering innovation talents in colleges and universities, discusses the practical teaching reform of school-enterprise collaborative cultivation of engineering innovation talents based on the concept of OBE, and puts forward the corresponding implementation path. It will be of great significance to improve the quality of engineering innovation talents training in colleges and universities. Future research can further explore the effectiveness and feasibility of the implementation path, and promote the school-enterprise collaborative engineering innovation talent cultivation to achieve greater results.

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