

Research on the OBE-oriented Multi-party Linkage Mechanical Engineering Professional Degree Graduate Training Mode: A Case Study of Hebei University of Engineering

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Abstract: The development of strategic emerging industries and leading industries in Hebei Province, as well as the needs of regional industrial transformation and upgrading, have put forward higher requirements for the mechanical professional degree postgraduate education that aims to cultivate talents who can solve practical engineering problems and carry out technological research. However, at present, most of the mechanical professional degree postgraduate training generally has problems such as the disconnection between talent training goals and social needs, the disconnection between teaching content and industry development, and the disconnection between students' theoretical knowledge and engineering applications. In order to meet the needs of social and economic construction and industry development for mechanical professional degree postgraduate talents, it is necessary to build a mechanical compound applied talent cultivation ecosystem with the school as the center and multi-party cooperation, so as to deepen the collaborative education among the department, enterprises, schools and institutes, promote the cross-integration of multiple disciplines and majors, and enhance the practical innovation ability of degree holders.

Keywords: OBE; Multi-Party Linkage; Professional Degree; Training Mode

1. Introduction

Strategic emerging industries represent the direction of global technological revolution and industrial transformation, serving as a crucial force for leading future development [1]. Currently, Hebei Province is vigorously

promoting the development of strategic emerging industries, aiming to create new competitive advantages in high-end equipment manufacturing. This is both a new driving force for the development of masters education in mechanical engineering and a significant challenge for the reform of teaching and education in mechanical engineering masters programs [2].

“Practice and innovation” is the key word of talent innovation ability. The cultivation and promotion of practice and innovation ability are produced in the cycle of “practice, theory, re-practice and innovation”. Practice is the basis of innovation, and innovation provides guidance for practice. Graduate education is the best inter-section of education, science and technology, and talent, serving as a crucial force for advancing new-quality productivity [3]. To build a first-class talent training system, we must further promote deep-level education and teaching reform.

How to solve the problem from the fundamental logic of talent training, realize the organic integration and benign interaction of teaching, scientific research and practice, and establish a postgraduate training system of compound applied mechanical professional degree matching the coordinated development of Beijing-Tianjin-Hebei and the demand of serving local construction is of great significance to serve the strong province of science and technology [4], undertake the industrial development of Beijing and Tianjin and promote industrial upgrading.

2. Training Mode of Graduates in Composite Applied Mechanical Engineering at Home and Abroad

The University of Aachen has set up a series of platforms for deep integration between

academia and industry, forming a multi-dimensional "innovation cluster" development model. The deep integration of "basic research" and "engineering technology" has continuously provided innovation impetus to the University of Aachen and ensured the long-term prosperity of German manufacturing industry.

Tsinghua University puts forward the training concept of "solid foundation theory, extensive frontier knowledge and emphasis on practical application", and closely combines engineering practice with courses and practices, plays the role of dual mentors from universities and enterprises and multi-disciplinary mentors, and strengthens the deep integration of "basic research" and "engineering practice".

Hebei University of Engineering attaches great importance to the cultivation of graduate students practical innovation ability. Through the construction of mechanical professional degree talent training system with "resource sharing, discipline co-construction and talent co-cultivation", the quality of talent training is improved.

3. Problems Existing in the Training of Mechanical Professional Degree Graduates

3.1 The Training Objectives Do Not Match the Social Needs

Talent training still attaches great importance to knowledge transmission, and has not been able to adjust the training goals according to the needs of social development, industry and enterprises, as well as the needs of students themselves, resulting in the disconnection between degree construction and student training, and between professional knowledge and innovation ability [5].

3.2 The Integration of Disciplines is Not Tight

Teaching activities are still mainly organized by traditional single-discipline organizations, and subject research is usually organized by departments based on single disciplines, which makes it difficult to break through the barriers of disciplines and jump out of professional fences, so that students enter "disciplinary silos" early.

3.3 There is Insufficient Training Resource Integration in the Program

The poor coordination among various educational subjects, the unclear understanding of their role and responsibilities in talent training, leads to the failure of the multi-subject coordination mechanism to be effectively established, and the effect of the industry-education integration talent training mode is difficult to achieve a breakthrough [6].

3.4 Students' Practical Ability and Innovation Awareness are Not Strong

The training of graduate students still has the problem of valuing papers, neglecting engineering and relying on simulation. The role of practical training bases and academic platforms in cultivating talents is not fully played, and some teachers lack practical ability, which cannot guarantee the effective improvement of students practical ability and innovation awareness [7,8].

4. Measures for the Reform of Graduate Training in Mechanical Professional Degree

4.1 Build a Student-Centered Teaching Model

Based on the positioning of local applied universities as "oriented towards industries and rooted in the locality," the school and enterprises jointly formulate talent cultivation programs, promoting the integration of enterprises into teaching and cases into courses, establishing a knowledge network that complements theoretical knowledge with engineering practice. By adopting a two-stage approach of integrating research outcomes into teaching and student participation in mentors research projects, students acquire the theoretical knowledge and basic research capabilities required by industry.

Oriented by meeting the individual development needs of students, we have formulated a "teaching, technology and research" trinity collaborative talent training plan of "course foundation building, skill improvement and scientific research cultivation", strengthening the mastery of knowledge and ability in three links: professional knowledge, skill practice and scientific research training, enriching and perfecting teaching methods, and promoting the deep integration of industry-university-research.

Construct modular courses that integrate new

elements of interdisciplinary disciplines, build new technical courses such as “intelligent manufacturing” and “artificial intelligence”, and optimize the curriculum system driven by actual engineering projects. Relying on the overall plan of Hebei Provinces provincial backbone university '1 + N ' docking with universities such as Beijing and Tianjin, we will deepen the multi-faceted and deep-level exchanges and cooperation with universities in Beijing and Tianjin in the mechanical specialty.

4.2 Establish a Multi-party Linkage Talent Training Model

Based on the demand of regional economic and social construction for the training of professional degree postgraduates, we should strengthen the leading position of talent training in colleges and universities, do a good job in the integration of various factors on the supply side of education and the demand side of industry, coordinate the relationship between the main bodies of education, clarify the responsibilities of all parties [9], and realize the efficient "flow" and "transformation" of resources of all parties.

Excavate scientific and technological innovation elements and talent training resources such as universities, industries, enterprises and institutions, give full play to the role of government policy guidance, industry guidance and enterprise (institution) leadership, set up practice platform, realize the implementation by the main body of the school, take the construction of professional degree graduate practice base as an opportunity, and construct a linkage training mode driven by the government, industries and enterprises (institutions). Through platform sharing, think tank construction, scientific research and other ways to achieve "resource sharing, discipline co-construction, talent co-education", establish a university as a talent training center, government, industry, enterprises (institutions) multi-driven linkage training mode.

High-level technical personnel from enterprises to jointly form a "dual-qualified" mentor team providing strong support for talent cultivation will be actively introduced [10,11]. And we will conduct practical capability certification work for in-school mentors encouraging young mentors and teachers to participate in actual engineering projects and industry-university cooperation

projects to enhance research capabilities.

4.3 Establish a Talent Training System Under Ecological Vision

Relying on the main sports talents resources, we will construct an educational environment consisting of three parts: evaluation mechanism, internal environment, and external environment, with the output outcomes being "ideological value + professional theory + practical skills + scientific literacy", and establish a cyclic progressive talent cultivation ecosystem of "theory-practice-innovation-theory enhancement", forming an OBE-oriented mechanical professional degree graduate training system.

In accordance with the principle of "the advancement of theoretical knowledge and the practicability of technical methods", the curriculum system is optimized for the knowledge system required in product design, technology research and development, engineering management, etc., and the subjective initiative of each educational subject is given full play in the course setting, and the curriculum is set up according to the needs of the industry and enterprises, reflecting the professionalism, practicability and cutting-edge nature of the curriculum.

Focusing on the three dimensions of theory, practice and innovation, and comprehensively examining the five links of knowledge mastery, experiment completion, practice achievement, project contribution and significant results, we establish an "three-dimensional and five-degree" evaluation ecology for mechanical talents, paying attention to the combination of process evaluation and summative evaluation.

Taking "refined elements and mutual integration of specialized thoughts" as the condensed case, "six-stage output" is taken as the outcome, forming a ideological and political education ecology of "ideological and political courses + ideological and political courses" with degree of achievement, degree of concealment, degree of emotion, degree of acceptance and degree of satisfaction as the measurement criteria, so as to ensure the effect of ideological and political education.

4.4 Establish a Long-term Training Mechanism for the Integration of Industry and Education

By integrating resources from multiple parties

including government, industry, academia, research, and application through the disciplinary platform, using research projects as the driving force, orienting towards serving local economic development, and aiming at solving technical problems in the industry, we collaborate with enterprises to form a mentor team, jointly develop talent cultivation programs, bring the latest technologies in the industry into the classroom, and strengthen practical education through case teaching.

Focusing on the integration of education and research, as well as the combination of teaching cases and engineering projects, experts and distinguished teachers from the disciplinary platform and technical backbone personnel from enterprises are invited to undertake part of the teaching tasks. Through extensive case teaching, students are cultivated to develop comprehensive problem-solving abilities in practical situations, helping them form a basic professional framework, master the fundamental theories required for their major (occupation), and understand the future directions and trends of career development.

We will promote the transformation of "teacher-student mutual selection" from department system to platform system and project system, encourage teachers from different disciplines to form mentor groups based on platforms or projects to jointly guide graduate students, and promote interdisciplinary integration.

4.5 Improve the Quality of Compound Application-oriented Personnel Training

We will strengthen the construction of required courses, elective courses and practical links, carry out on-site teaching in combination with the actual engineering, build engineering cases (cases), use modern information technology to establish online classrooms and online lecture halls, and invite experts and scholars to teach online.

Full play will be given to the expertise of enterprise experts and university teachers, build a talent training platform through engineering practice, project research and development cooperation, promote the joint training of graduate students between universities and enterprises, and enhance students innovation awareness and scientific research ability [12,13].

5. Implementation Results

Facing the industry and society's demand for talents with mechanical majors, we are results-oriented and construct: "student-centered, comprehensively improve student output results under the guidance of OBE theory" and "internal and external circulation from an ecological perspective (inside: classroom teaching, Laboratory, subject platform, on-campus internship practice; external: competitions, projects, enterprises, academic exchanges, etc.)" and the "educational ecology of professional degree graduate students in three stages of cyclical and progressive training of theoretical learning, practical training, and innovation improvement" environment".

Using an educational ecological approach, multiple educational factors such as scientific and technological development, local economy, school system, teacher-student groups, and individual students are incorporated into talent training, and the quality of talent training is improved by building a multi-party linkage and collaborative education graduate training system for mechanical majors.

(1) Teaching satisfaction is on the rise

According to the comprehensive evaluation of the training program, course content, practical links and the ability and quality level of tutors for mechanical professional degree graduate students from 2022 to 2024, the results show that the teaching satisfaction is increasing year by year.

(2) The tightness between talent training and social needs continues to increase

According to the differences in students' development goals and learning abilities, measures should be taken to teach students according to their aptitude. With tutors and science and technology missions (members) as bridges, relying on scientific research platforms and enterprises to provide scientific research resources and practical environment, a multi-dimensional linkage mechanism of tutors + platforms + science and technology missions should be established. 87% of professional degree graduates have entered enterprises to participate in practical scientific research projects since their second year, and 100% of them have completed the thesis opening in enterprises.

(3) Students practical innovation ability continues to improve

Relying on the achievements, progress, and experience of mentors in scientific research and engineering practice, the integration point between engineering practice and theoretical knowledge has been identified, achieving 100% coverage of course case-based teaching, with 100% of students graduation theses coming from production practice, participating in 63 teacher research projects, publishing 103 high-level papers, obtaining 12 authorized patents, and winning 21 national awards including those from the Robot Innovation Design Competition and Mathematical Modeling Competition.

6. Conclusion

According to the different needs of students, the OBE-oriented multi-linkage mechanical degree postgraduate training mode adapts to the talent training requirements based on achievement orientation and ability standard under the background of new engineering through differentiated guidance, gives full play to the role of school-led, policy-guided and enterprise-guided, and constructs a multi-linkage education system such as schools, government and institutions. To create a double-link and three-level education approach of "school + platform + enterprise" and "classroom + practice + project" linked by tutor + science and technology mission (member), so as to meet the inherent needs of students' individual development and the needs of social development for mechanical degree graduate students; Realize the virtuous circle of educational ecological environment such as out-of-school environment, in-school small environment, teacher-student group micro-environment and students' individual internal environment, and construct an ecosystem suitable for the cultivation of professional degree graduate students.

Acknowledgements

This paper was supported by 2023 Hebei graduate education teaching reform research project "Research on the Cultivation System of Compound Applied Mechanical Professional Degree Postgraduates from the Perspective of Ecology and through Multi-party Linkage and Collaborative Education" (YJG2023093).

This paper was supported by 2023 Research and practice project of Innovation and Entrepreneurship education in colleges and

universities in Hebei Province "Research on the Improvement of Collaborative Innovation Ability of Teachers and Students driven by Mass Innovation Ecology" (2023xcxy345).

This paper was supported by 2023 Graduate education teaching reform project of Hebei University of Engineering "Research on "teaching competition research" tripartite collaboration to enhance the application innovation ability of master students in engineering under the background of powerful education" (XYJG20240012)

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