Check for updates

Research on Practical Teaching of Professional Masters in Engineering Based on Competency Development

Xinxun Zhang, Qiqing Fang, Wei Zhang, Shanyong Wei*, Chenggang Gu, Yuning Zhang

Air Force Early Warning Academy, Wuhan 430074, Hubei Province, China

*13767167332@163.com

Abstract. Against the backdrop of rapid technological development and the steady advancement of China's modernization drive, there is an increasingly urgent demand for high-level, application-oriented, and interdisciplinary talents in the field of support engineering. As a key bridge connecting higher education and industry needs, professional master's education relies on practical teaching as the core carrier to achieve its talent training goals. However, current practical teaching of professional master's programs in support engineering faces prominent issues, including inadequate adaptability of the curriculum system, lack of appeal in practical teaching, insufficient practical teaching conditions, and outdated teaching models. To improve the training quality of these professional masters, this paper proposes targeted reform paths from four dimensions: optimizing curriculum system design, improving practical teaching content, constructing a collaborative teaching mechanism, and integrating two types of educational links. These reforms aim to transform practical teaching from "cognitive internship" to "hands-on practice" and from "knowledge input" to "output of innovative capabilities and post competence", providing a reference for the practical teaching reform of related professional master's programs.

Keywords: Professional masters in engineering; Practical teaching; Talent training; Reform paths

1 Introduction

With the iterative upgrading of modern technologies, the transformation and optimization of educational models, and the continuous improvement of job competency requirements, higher standards have been set for the knowledge structure, practical abilities, and innovative literacy of talents in the engineering field. Professional master's education takes cultivating professional talents who meet job needs and solve practical engineering problems as its core mission, among which practical teaching is the key support to achieve this goal. The training quality of professional masters in engineering is directly related to the exertion of talent efficiency, the development of scientific and technological undertakings, and the technological innovation and sustainable progress of related industries. However, the traditional practical teaching system has gradually

T. Chamaratana et al. (eds.), *Proceedings of the 2026 12th International Conference on Digital Humanities and Frontiers in Social Sciences (DHFSS 2026)*, Advances in Social Science, Education and Humanities Research 1031,
https://doi.org/10.2991/978-2-38476-611-6_9

revealed incompatibility with the talent training needs of the new era, requiring urgent systematic reform.

In-depth analysis of the shortcomings and bottlenecks in the practical teaching of professional masters in engineering and exploration of scientific and effective reform paths are not only the inherent requirement for improving the training quality of professional masters in engineering but also an important measure to serve national construction and industrial development and assist in the implementation of the strong country strategy, which has important theoretical value and practical significance. Through the reform of practical teaching, it is possible to promote the precise connection between talent training and job needs, and deliver more high-quality application-oriented and interdisciplinary talents to the engineering field.[1]

At present, domestic research on the reform of practical teaching for professional masters has achieved certain results. Some universities have proposed optimization schemes for teaching models such as "university-enterprise cooperation" and "project-driven" for professional masters in engineering. However, research on practical teaching targeting the distinctive major of engineering is relatively scarce.[2] Most existing studies focus on superficial adjustments to the curriculum system, lacking systematic exploration of the advanced nature of practical teaching content, the coordination of teaching mechanisms, and the connection of educational links, which is difficult to meet the special needs of the training of professional masters in this field.

2 Problems Existing in the Practical Teaching of Professional Master in Engineering

Cultivating high-level, application-oriented, and interdisciplinary talents is the core goal of professional master's education, and the construction of the curriculum system and the development of practical teaching are the key supports to achieve this goal.[3] Currently, with the continuous improvement of talent competency requirements driven by the development of engineering majors, a series of problems incompatible with the training goals have gradually emerged in teaching practice, seriously restricting the improvement of talent training quality. Specifically, there are obvious shortcomings in multiple links such as curriculum system setup, practical teaching implementation, and teaching model adaptation, which urgently require systematic sorting out and targeted optimization.

2.1 The Curriculum System is Difficult to Adapt to Talent Training Needs

Students come from diverse backgrounds, including in-service personnel with work experience and fresh undergraduate graduates lacking practical experience. However, the curriculum setup does not fully consider the differences in knowledge foundation, job needs, and abilities of different students, resulting in a "one-size-fits-all" phenomenon. The curriculum system still focuses on traditional single-system engineering, conventional operation management, and technical support courses, lacking in-depth and expanded courses such as systematic engineering capabilities oriented towards the overall engineering system, efficiency-oriented comprehensive services, and system operation optimization. Some courses are offered randomly based on availability, with low differentiation from undergraduate content, making it difficult to reflect the advanced and practical requirements of the postgraduate level.

2.2 Insufficient Attractiveness of Practical Teaching

In terms of curriculum setup, due to the lack of equipment, the number of practical projects is obviously insufficient. Coupled with the limitations of venues and practical conditions, only the most basic cognitive and verification practices can usually be completed, which fails to stimulate students' enthusiasm for exploring the unknown. Students are in a passive state of accepting arrangements during practice, lacking subjective thinking and initiative.[4] In addition, in terms of curriculum arrangement, most teachers and students ignore the important role and status of practical courses, considering them dispensable. The proportion of assessment scores for practical courses is small, and even some practical courses only assess scores based on attendance and practical reports, which does not inspire students' understanding of the importance of practical courses and also affects the effect of practical teaching.

2.3 Shortcomings in Practical Teaching Content and Conditions

The core courses for professional master's programs in engineering have specific requirements for practical class hours, but engineering management courses lack appropriate practical content, making it difficult to meet this standard.[5] Some practical teaching has degenerated into simple skill training, disconnected from talent needs; some visits and studies are mere formalities, lacking substantive content. In addition, the insufficient practical teaching platforms and environments are difficult to support the development of advanced and comprehensive practical projects, restricting the cultivation of students' comprehensive abilities.[6]

2.4 Inadequate Support from Traditional Teaching Models

Under the traditional "classroom + laboratory" model, classrooms focus on theoretical teaching, with students passively accepting knowledge; laboratories emphasize simple verification of knowledge, lacking application-oriented and innovative practical projects.[7] This model lacks targeted on-the-job practice environments and large-scale comprehensive practical projects, resulting in insufficient cultivation of students' comprehensive application capabilities and innovative expansion capabilities, which is inconsistent with the training goals of application-oriented and interdisciplinary talents.

The emergence of the aforementioned problems stems from the deep-rooted constraints of traditional educational concepts, the practical limitations of insufficient resource allocation, and the institutional barriers of ineffective systems and mechanisms. In essence, the core contradiction in the practical teaching of Equipment Support Engineering for professional master's degree programs lies in the structural mismatch between the talent cultivation supply side and the industry demand side. On one hand, there is an urgent demand for high-quality applied talents in the equipment support field; on the other hand, there exists the cultivation dilemma of graduates requiring prolonged job adaptation periods and lacking sufficient competence in solving practical engineering problems. This contradiction has become particularly prominent today, amid the accelerated iteration of equipment technology and the profound transformation of support models, compelling profound, systematic, holistic, and collaborative reforms in practical teaching.

Therefore, it is necessary to research and explore the curriculum and practical teaching of professional masters in engineering in response to the needs of educational development, which is of great significance for improving the training effect of professional masters in engineering.

3 Reform Paths for the Practical Teaching of Professional Master's Programs in Engineering

3.1 Optimize Curriculum System Design and Construct a "Two-Way Coupling" Model

The curriculum design for professional master's students should not only meet the needs of cultivating interdisciplinary and application-oriented talents but also reflect the comprehensiveness and advancement of knowledge, enabling professional master's students to possess a solid cultural foundation and a reasonable knowledge structure. The curriculum should be oriented towards practical application and the ability to solve practical problems, focusing on job demand-driven development. In the curriculum system design for professional masters, a combination of the ADDIE (Analysis-Design-Development-Implementation-Evaluation) model and backward design method can be adopted, combined with the demonstration and adjustment of the college's curriculum system, to establish a core curriculum system with "two-way coupling" between students' current ability status and training goals. By analyzing students' ability shortcomings and evaluating existing teaching conditions, training goals are decomposed into distinguishable ability items, and curriculum modules are reversely matched based on these ability items. Meanwhile, consideration is given to making up for students' ability shortcomings and the constraints of existing teaching conditions, ultimately constructing a comprehensive professional curriculum system that progresses from basic theories to cutting-edge technologies and then to engineering applications.

Differentiated and tiered cultivation shall be implemented targeting students from diverse educational backgrounds. For in-service students with frontline work experience, emphasis shall be placed on strengthening their cultivation in equipment system support theory, cutting-edge technology application, and management innovation capabilities, facilitating their transition from experience-based support to scientific support. For fresh graduates, preparatory practice modules such as equipment support cognitive internships and typical equipment disassembly practices shall be added to compensate for their deficiency in engineering practical experience. Meanwhile, a dynamic curriculum update mechanism shall be established, whereby course content is updated annually in accordance with new technologies, methodologies, and models in the equipment support field, and cutting-edge achievements such as intelligent equipment support, predictive maintenance, and big data fault diagnosis are promptly integrated into teaching to ensure that course content remains in sync with industry development.

3.2 Improve Practical Teaching Content and Build Advanced Practical Platforms

According to the characteristics of core courses, construct diversified practical platforms oriented towards advanced competency cultivation and carry out project-based experimental practice. Coordinate the joint teaching and training resources of universities, research institutes, and enterprises to build a practical teaching platform system of "on-campus laboratories + research institute R&D centers + enterprise job positions". Strengthen the advanced nature and connection of practical teaching content, reduce simple skill training and formalized visits and studies, and increase comprehensive and innovative practical projects to ensure the precise connection between practical teaching and talent needs.

3.3 Construct a "Trinity" Collaborative Teaching Mechanism

Based on goal-setting theory and focusing on students' ability training, an integrated teaching model of education-use-industry integration is explored, and a "trinity" curriculum teaching linkage mechanism of "universities + factories/institutes + enterprises" is constructed. This mechanism connects the ability training path of students from theoretical learning to project practice and then to on-the-job application. Universities are responsible for theoretical basic teaching and training program design, factories/institutes provide R&D practice platforms and technical guidance, and enterprises create on-the-job practice environments and practical engineering problems, realizing the in-depth integration of theoretical teaching, practical training, and job needs. Regarding the specific operational mechanism, a tripartite joint cultivation steering committee can be established to collaboratively formulate training programs, design practical projects, and evaluate cultivation quality. A "dual-tutor system" should be implemented, whereby university supervisors are responsible for theoretical guidance and academic quality control, while supervisors from research institutes and enterprises oversee practical instruction and on-the-job mentoring. Joint practical teaching bases should be established to create realistic practice scenarios integrating equipment research and development, fault diagnosis, and effectiveness evaluation, enabling students to refine their ability to solve complex engineering problems through authentic engineering projects.

3.4 Integrate Professional Master's Education with On-the-Job Education

Both postgraduate education and in-service education play important roles in talent development. However, at present, there is a lack of organic connection and overall consideration between the two, resulting in problems such as waste of teaching resources, overlapping courses and teaching content, duplicate teaching objects, and low training efficiency. Exploring the integrated cultivation of professional degree postgraduate education and in-service education can give full play to the two advantages of postgraduate education focusing on innovative competency cultivation and in-service education focusing on job competency cultivation. By integrating the two types of resources and constructing an interconnection mechanism, the path from innovative competency cultivation to on-the-job competence is opened up, thereby continuously improving the quality and efficiency of talent training.

4 Conclusion

This paper addresses the problems existing in the practical teaching of professional masters in engineering, such as inadequate adaptability of the curriculum system, lack of attractiveness in practical teaching, insufficient teaching conditions, and outdated teaching models, and proposes reform paths from four dimensions: curriculum system optimization, practical content improvement, collaborative mechanism construction, and educational link integration. In the future, it is necessary to further consolidate the joint efforts of universities, research institutes, and enterprises, continuously optimize the allocation of practical teaching resources, strengthen the process management and quality evaluation of practical teaching, and constantly improve the new practical teaching ecology oriented towards "hands-on practice" and "competency output". This will cultivate more high-level, application-oriented, and interdisciplinary talents for the engineering field and provide solid talent support for industrial construction and development.

Disclosure of Interests

The author declares no conflict of interest.

References

1. YE M L, JIANG X L, ZHU C P, et al. On the innovation of school-enterprise cooperative education model in Wuzhou University: Taking pharmaceutical majors as an example[J]. Journal of Higher Education, 2020(1): 135-136+139. https://doi.org/10.19980/j.cn23-1593/g4.2020.01.044
2. HUO X L, LI X H, LI Q. Design of practical teaching for testing equipment in "command and control equipment maintenance"[J]. Experiment Science and Technology, 2025, 23(1): 67-73. https://doi.org/10.12179/1672-4550.20230383
3. ZHANG W L, ZHANG L J, YIN J, et al. Development countermeasures of disciplinary evaluation system under the background of "Double First-Class"[J]. Journal of Higher Education Research, 2022, 45(1): 81-84. https://doi.org/10.3969/j.issn.1672-8874.2022.01.013
4. QIN G F, ZHANG D D, YIN X F, et al. Practice of integrating the concept of "strengthening core and consolidating system" into the talent training process of computer major[J].

Experimental Technology and Management, 2021, 38(7): 217-221. https://doi.org/10.16791/j.cnki.sjg.2021.07.041

5. LIU Q Y, LIU X Y. Reverse construction of classroom teaching evaluation indicators based on experts' comments[J]. Journal of Higher Education Research, 2022, 45(1): 90-97. https://doi.org/10.3969/j.issn.1672-8874.2022.01.015
6. LI Z W, ZHANG F, YANG D Q. Research on the teaching reform of financial training courses under the background of digital transformation[J]. Guide to Science and Education, 2024(15): 69-71. https://doi.org/10.16400/j.cnki.kjdk.2024.15.023
7. MA Y. Exploration on the practice of college teaching reform under the student-centered concept[J]. University Education, 2022(12): 22-24. https://doi.org/10.3969/j.issn.2095-3437.2022.12.006