



Comprehension and Practical Training of Professional Master's Degree Students in Vocational Education: A Case Study in Civil Engineering and Water Conservancy

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Abstract. The talent cultivation goal of vocational education professional degree graduate education is "excellent on-site engineers". At present, the vocational education degree system in China, which is parallel to the general education degree system, has been fully formed. These two lines are: high school vocational college undergraduate (engineer) professional degree graduate (excellent engineer), secondary vocational college vocational education undergraduate (on-site engineer) vocational education professional degree graduate (excellent on-site engineer). Sichuan Vocational and Technical College of Architecture has established a joint training and teaching site for graduate students majoring in civil engineering and water conservancy at Sichuan University of Light Industry and Chemical Technology, Southwest University of Science and Technology, and Chengdu University of Technology, for practical exploration.

Keywords: Vocational education professional degree graduate student; Professional degree graduate students; Joint cultivation.

1 Introduction

Vocational education is a crucial aspect of China's educational system, playing a fundamental role in cultivating high-quality talent. Given its parity with general education, vocational education should be extended to postgraduate levels. Currently, China is fostering the development of high-level vocational education talent, with a particular focus on professional master's degree students. We argue that professional master's degree students in vocational education, as a form of specialized training, differ significantly from their counterparts in traditional higher education institutions.

The State Council's National Vocational Education Reform Implementation Plan outlines in Article 4, "Improving the High-level Applied Talent Training System" [1], that a modern vocational education system should emphasize both academic education and practical training, establishing pathways for the development of technical and

skilled talent. The plan promotes a professional master's degree training model driven by vocational demands, prioritizing practical skill development and the integration of industry, academia, and research. This approach aims to enhance the training of professional master's degree students.

Article 15 of the Vocational Education Law of the People's Republic of China (Revised 2022) states: "Higher vocational education is delivered by higher vocational schools and general higher education institutions at the associate degree, bachelor's degree, and higher levels. Other schools, educational institutions, or eligible enterprises and industry organizations may, in accordance with the unified planning of the education administration, implement corresponding levels of vocational education or offer credit courses included in talent training programs."

China has established the world's largest vocational education system, with 11,200 vocational schools enrolling over 29.15 million students. Among these institutions, 32 are vocational undergraduate schools, and projections indicate that by 2022, a total of 936 accredited vocational undergraduate programs will be operational nationwide [2]. Together with graduates from applied undergraduate and general undergraduate programs, there is a sufficient pool of candidates for vocational education professional master's degree programs.

The emphasis has shifted from assessing the feasibility of cultivating vocational education professional master's degree students to focusing on practical implementation. Currently, China's vocational education master's and doctoral programs primarily train educators for vocational education. Considering the unique characteristics of vocational education, it is both practical and urgent for vocational colleges to offer professional master's degree programs aimed at developing high-level vocational education talent.

Preliminary research suggests that vocational colleges with sufficient student resources and faculty expertise are well-positioned to conduct vocational education professional master's degree programs. The specific approach should involve a thorough examination of the similarities and differences between the objectives of vocational education for professional master's degree students and the existing requirements for professional master's degree students.

2 Analysis of the Attributes of Professional Master's Degree Students in Vocational Education

2.1 Talent Development Objectives in Professional Master's Degree Programs in Vocational Education

The primary objective of vocational education is to develop application-oriented professionals and socialist workers who possess a combination of cultural knowledge and professional skills. These individuals are expected to contribute to the construction of socialism. Unlike general and adult education, vocational education significantly emphasizes the cultivation of practical skills and real-world abilities [2].

At the postgraduate level, vocational education should prioritize training application-oriented professionals who are equipped with advanced vocational technical skills

and specialized scientific and cultural knowledge. Drawing from the practical experiences of countries like Germany, it is evident that there is a demand for vocational education at this level. Germany, for example, has successfully trained numerous professionals at the postgraduate level.

Since 2009, academic master's degree students and professional master's degree students have been admitted separately, creating two distinct levels of master's degree education with different cultivation goals. On November 24, 2023, the Ministry of Education issued the Opinions on Deepening the Classified Development of Academic Degrees and Professional Degrees in Graduate Education (Document [2023] No. 2) ^[3], which explicitly states:

“Both types of degrees are equally important. Academic and professional master's degree education are crucial pathways for the country to cultivate high-level innovative talents. Both should emphasize solid foundational theories, systematic specialized knowledge, an innovative spirit, and innovative capabilities in graduate students. Academic degrees are based on first-level disciplines and awarded by category, focusing on the need for knowledge innovation and the cultivation of academically innovative talents with high academic literacy, a strong original spirit, and solid research capabilities. Professional degrees are awarded based on the category of professional degrees, focusing on industry needs and industrial development, and cultivating practice-oriented innovative talents with a solid professional foundation, strong practical abilities, and high professional literacy.”

Given the characteristics of vocational education and the levels of graduate education, it is evident that vocational education at the graduate level falls under the category of professional master's degree education. To distinguish it from general professional master's degree programs, we refer to it as professional master's degree education in vocational education.

The Opinions on Deepening the Classified Development of Academic Degrees and Professional Degrees in Graduate Education (Document [2023] No. 2), issued by the Ministry of Education, proposes to “reform professional master's degree education by leveraging the cultivation of outstanding engineers” ^[3]. This document clearly defines the cultivation of “outstanding engineers” as the primary goal of professional master's degree education.

Additionally, the General Office of the Ministry of Education, along with four other departments, issued the Notice on Implementing the Special Training Plan for Vocational Education On-site Engineers (Document [2022] No. 2) ^[4]. This notice addresses the talent shortage in technical positions within key areas of digital and intelligent vocational scenarios. It specifies that production enterprise job requirements will be selected and published to align with vocational education resources. Using the Chinese-style apprenticeship system as the main training method, the plan aims to explore and establish standards for on-site engineer training through practice. It also seeks to build several on-site engineer colleges and cultivate a wealth of on-site engineers with a craftsmanship spirit, proficient operational skills, process understanding, management capabilities, collaboration skills, and innovative abilities. By 2025, the project aims to involve at least 500 vocational colleges and 1,000 enterprises, and to train at least 200,000 on-site engineers.

China has now established a comprehensive vocational education degree system parallel to the general education degree system. These two pathways are: high school—associate degree—bachelor's degree (engineer)—professional master's degree (outstanding engineer) and secondary vocational school—higher vocational school—vocational bachelor's degree (on-site engineer)—vocational education professional master's degree (outstanding on-site engineer). Consequently, the goal of cultivating “outstanding on-site engineers” is firmly established as the talent cultivation objective of professional master's degree education in vocational education.

2.2 Examining the Characteristics of Professional Master's Degree Education in Vocational Education

On March 14, 2018, the Academic Degrees Committee of the State Council and the Ministry of Education issued the Notice on Adjusting the Categories of Engineering Professional Degrees (Document [2018] No. 7) ^[5]. This notice mandated the integration of the cultivation of professional talents for the Master of Engineering and Doctor of Engineering degrees. Consequently, the engineering professional degree categories were adjusted to eight distinct fields: Electronic Information (Code 0854), Mechanical Engineering (Code 0855), Materials and Chemical Engineering (Code 0856), Resources and Environment (Code 0857), Energy and Power (Code 0858), Civil and Hydraulic Engineering (Code 0859), Biology and Medicine (Code 0860), and Transportation (Code 0861).

The Development Plan for Professional Master's Degree Education (2020-2025) outlines several key objectives ^[6]. The plan aims to promote a steady increase in the number of master's professional degree programs through gradual expansion. It seeks to strategically extend the authorization layout for these degrees, thereby broadening their scope and availability. Newly authorized institutions should, in principle, focus exclusively on professional master's degree education, with new authorization points primarily concentrated on professional degree programs. Additionally, the plan encourages institutions to voluntarily convert revoked academic degree authorization points into professional degree authorization points.

Moreover, the plan emphasizes the construction of industry-education integration and joint training bases as critical components for applying for master's professional degree authorization points, without requiring previously obtained academic degree authorization points as a prerequisite. It seeks to align master's professional degree authorizations closely with regional, industrial, and sectoral development needs. Finally, the plan supports degree-granting institutions in optimizing their talent training structures, prioritizing the increase in master's enrollment plans for professional degrees.

Professional degrees are oriented towards practical application and vocational practice, emphasizing hands-on skills and real-world implementation. Their primary goal is to cultivate high-level professionals who receive rigorous, high-quality training in their respective technical fields. A distinctive feature of professional degree education is the close integration of academic and vocational components. Individuals who earn professional degrees typically pursue careers with a clear professional focus, such as engineers, architects, physicians, teachers, lawyers, accountants, foresters, and artists, rather

than engaging in academic research. Vocational education professional degrees specifically focus on developing practical skills and work-related competencies. They aim to train on-site professionals who possess advanced technical skills along with specialized scientific and cultural knowledge.

The country is increasingly emphasizing professional master’s degree education; however, the development of vocational education professional master’s degree programs remains in its exploratory stage. Preliminary surveys of enterprises and graduates from vocational education programs indicate that vocational education professional master’s degree programs should build upon the existing professional master’s degree education framework.

In this model, vocational education professional master’s degree students would conduct their thesis writing and research at higher vocational colleges and partnering enterprises while attending classes at regular undergraduate universities. This approach leverages the strengths of both regular undergraduate universities and vocational colleges, thereby highlighting the unique characteristics of vocational education and preserving its distinct features. The primary aim is to cultivate graduates who meet the specific needs of the vocational education sector. Table 1 presents a comparative analysis of the characteristics of vocational education professional master’s students and general professional master’s students.

Table 1. Comparative Analysis of Characteristics between Vocational Education Professional Master’s Students and General Professional Master’s Students

Key Points/Categories	Vocational Education Professional Master’s Degree Students	General Professional Master’s Degree Students
Training Goals	Outstanding On-site Engineer	Outstanding Engineer
Training Levels	Master’s Degree Students	Master’s and Doctoral Degree Students
Scope of Training	Includes in-service teachers at secondary vocational schools pursuing a master’s degree and full-time academic master’s degree in vocational technical education	39 types of master’s professional degrees and 5 types of doctoral professional degrees, covering the main areas of national economic and social development
Guidance Model	Three mentors: undergraduate university, vocational college, enterprise mentor	Two mentors: undergraduate university, external mentor
Training Model	On-site engineer training model oriented towards vocational needs, emphasizing practical ability development and integration of industry, academia, and research	Engineer training model oriented towards vocational needs, emphasizing practical ability development and integration of industry, academia, and research
Training Locations	Undergraduate university, vocational college, partnering enterprises (industrial colleges, vocational education group enterprises, municipal industry-education alliances)	Undergraduate university, partnering enterprises

In recent years, with the successful implementation of China's "Double High" Plan for higher vocational education, several prestigious institutions have begun experimenting with vocational education professional master's degree programs, validating the insights presented in this table.

For instance, in April 2016, Wenzhou Polytechnic and Wenzhou University established a "Joint Master's Training Point," focusing on fields such as computer science, mechanical engineering, intelligent manufacturing, and education management. This pilot project for training engineering master's students emphasizes practical ability cultivation through industry-academia collaboration. Graduate students spend their first year studying at Wenzhou University and their second and third years at Wenzhou Polytechnic. The latter provides comprehensive policy support and a conducive environment for experiments, training, learning, and research.

In June 2021, BinZhou Polytechnic and the Shandong Polytechnic established joint graduate training bases with Shandong Normal University. BinZhou Polytechnic appointed several professors, recognized for their exceptional achievements in vocational education teaching and research, as "second supervisors" for the first cohort of jointly trained master's students. Additionally, Shenzhen Polytechnic University has signed agreements with over 100 domestic universities to jointly train master's and doctoral students. In April 2023, Heyuan Polytechnic became a master's training point for the Guangzhou Institute of Science and Technology.

Since 2013, Zhejiang Fashion Institute of Technology and Xi'an Polytechnic University have been conducting joint graduate training programs. They have made significant progress in developing collaborative training mechanisms for graduate students and cultivating "dual-qualified" mentors. After completing their coursework at Xi'an Polytechnic University, students are sent to vocational colleges to conduct applied research and complete their master's theses using vocational college projects and partnerships with enterprises. These jointly trained graduate students have achieved excellent results in the Graduate Innovation Achievement Exhibition of Shaanxi Province and the selection of the Yao Mu Academician Award Scholarship of the Xi'an Polytechnic University.

3 Practical Training for Vocational Education Master's Degree Students in Civil Engineering and Water Conservancy

Sichuan College of Architectural Technology has established specialized training and teaching centers for vocational education master's degree students in collaboration with Sichuan University of Science & Engineering, Southwest University of Science and Technology, and Chengdu University of Technology. Candidates are selected from graduates of civil engineering and water conservancy undergraduate programs at vocational colleges and other application-oriented undergraduate institutions. These selected students are then admitted to the vocational education master's degree program in civil engineering and water conservancy.

3.1 Admission Methods

The primary admission method for vocational education professional master's degree students is through the national unified graduate entrance examination, held annually in January. This method has been in place since the 2017 cohort. To better align with the characteristics of vocational education training, an additional application and interview process is also being considered alongside the national unified examination.

The admission methods for vocational education professional master's degree students vary based on training direction and objectives, differing from those for regular graduate students. For instance, students specializing in the operation and development of civil and hydraulic engineering require significant hands-on experience due to their focus on engineering operation technology research. This practical experience is crucial for completing their research effectively. Therefore, candidates with strong operational skills, along with a spirit of innovation and research, are better suited to meet the training objectives.

Thus, the proposed admission method for these students includes an application and interview process. The application requires the fulfillment of one of the following conditions: obtaining a second prize or above in provincial vocational skills competitions, achieving a third prize or above in national competitions, holding one invention patent (ranking in the top two, with the second-ranking applicant required to provide a contribution certificate from the first inventor), possessing two utility model patents (ranking first, with each patent valued over 10,000 RMB), or having two or more published papers in relevant professional journals (ranking first or second, with the second-ranking author required to provide a contribution certificate from the first author).

Meeting these application criteria ensures that the applicant satisfies the admission requirements for vocational education graduate training. The authenticity of the applicant's research achievements is verified according to the review criteria. Additionally, an interview process is established to further evaluate whether the applicant's innovativeness, creativity, and fundamental qualities meet the required standards.

3.2 Duration and General Requirements

The duration for a Master's degree in Civil Engineering and Water Conservancy ranges from 2 to 5 years. Typically, the coursework lasts about 1 to 1.5 years, followed by approximately 1 to 1.5 years for the graduation project or thesis. Students are required to complete their coursework before proceeding to their graduation project and thesis writing.

For vocational education graduate students in Civil Engineering and Water Conservancy, the expected duration is 3 to 5 years, which is one year longer than the minimum duration for professional master's degrees. This extension allows students additional time to consolidate fundamental theories, familiarize themselves with practical skills, and master data processing methods. Typically, the coursework lasts about 1 year, and the graduation project or thesis takes approximately 2 years. Students first conduct research and write their thesis, then select and complete courses based on the needs of their research and mid-term assessment results.

3.3 Target Applicants

The target applicants for vocational education professional master's degree programs include both undergraduate students from vocational education colleges and regular universities. Applicants holding diplomas from higher vocational colleges must have a minimum of two years of engineering practice experience post-graduation. The primary focus is on outstanding graduates from vocational bachelor's programs. Additionally, exceptional graduates from application-oriented and general bachelor's programs are also considered.

Vocational education professional master's degree programs are designed to meet societal needs by cultivating high-level, application-oriented talents. These programs aim to develop individuals who possess solid foundational theories and professional knowledge in relevant fields, strong problem-solving abilities, the capacity to undertake professional technical or management roles, and exemplary professional ethics.

The recruitment of vocational education professional master's degree students emphasizes not only academic abilities but also practical and innovative capabilities. The primary categories of target applicants include undergraduates, diploma holders, and in-service professionals.

Undergraduates, who are bachelor's degree graduates including both general and engineering undergraduates, possess a solid foundation of professional knowledge and skills, enabling them to adapt quickly to the demands of professional master's degree studies.

Diploma holders, who are graduates with an associate degree, may have comparatively weaker professional knowledge and skills but often exhibit stronger practical abilities. Through professional master's degree studies, these diploma holders can further enhance their professional competencies.

In-service professionals, individuals with work experience including managers and technical personnel from enterprises and public institutions, can improve their professional skills and better meet workplace demands through professional master's degree studies.

3.4 Training Model

The training model for vocational education graduate students integrates the existing professional master's degree framework through a collaborative approach between schools and enterprises. In this model, vocational education colleges and enterprises oversee research and thesis writing, while theoretical courses are provided by traditional undergraduate universities.

These are jointly supervised by experienced instructors from higher education institutions with engineering practice backgrounds and senior engineering technical or management personnel from industrial and mining enterprises or engineering construction departments. Both the reviewers of the professional degree theses and the members of the defense committee must include experts holding senior professional technical positions from industrial and mining enterprises or engineering construction departments.

Currently, pilot master's students are taking theoretical courses at Sichuan University of Science & Engineering, Southwest University of Science and Technology, and Chengdu University of Technology. They participate in product quality improvement and upgrading research at enterprise research center laboratories and write their theses based on the research outcomes.

3.5 Graduation Requirements

The graduation project for vocational education professional master's degree students must originate from practical production needs or have a clear production background and application value. These projects should primarily focus on applied research topics, such as technical breakthroughs, technical renovation projects, or the development of new processes, equipment, materials, or products.

The degree thesis (or design) must be independently completed by the student and should demonstrate their ability to comprehensively apply scientific theories, methods, and technical means to identify and solve practical engineering problems innovatively.

Projects that undergo actual engineering application particularly align with the requirements for a vocational education master's degree and may be considered for selection as outstanding graduation designs.

4 Conclusion

Currently, two graduate students are undergoing pilot training in the Civil Engineering and Water Conservancy vocational education professional master's program. This program is a collaborative effort between Chengdu University of Technology, Sichuan University of Science & Engineering, Sichuan Vocational and Technical College, and several enterprises and research institutes.

After 1.5 years of study, each student has published a paper and obtained a utility model patent. They are now in the experimental data analysis stage for their second round of papers. Additionally, their self-developed capabilities have received high praise from partnering enterprises, with both students being recognized as outstanding interns and receiving awards.

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