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Exploration on Integrated Practical Teaching Path of Engineering Management Major Under the Background of Vocational College Upgrading to Undergraduate Education: From Vocational College Skill Mastery to Undergraduate Comprehensive Competence Improvement

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Abstract: The comprehensive advancement of the policy of vocational college upgrading to undergraduate education has brought new development opportunities for talent cultivation of the Engineering Management major, and put forward higher requirements for the teaching connection between vocational college and undergraduate stages. As the core carrier for cultivating application-oriented talents, the integrated quality of practical teaching directly affects the effectiveness of talent cultivation. Centered on the orientation of "improving from vocational college skills to undergraduate comprehensive competence", this paper first analyzes the policy requirements and practical significance of integrated practical teaching for the Engineering Management major under the background of vocational college upgrading to undergraduate education. Secondly, through investigation and research, it sorts out core problems such as disjointed connection, vague objectives, repetitive content, and scattered resources existing in current integrated practical teaching. Finally, from five dimensions including objective system reconstruction, content module optimization, teaching mode innovation, resource platform co-construction and evaluation mechanism improvement, this paper constructs an integrated practical teaching path, and puts forward feasible solutions for the connection of practical teaching of the Engineering major in the transition from vocational college to undergraduate education, so as to cultivate compound engineering management talents meeting industrial demands.

Keywords: Vocational college upgrading to undergraduate education; Engineering management; Practical teaching; Integration between vocational college and undergraduate education; Competence improvement

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1. Introduction

1.1. Policy background

In recent years, China has attached great importance to the development of modern vocational education. A series of policy documents such as *Implementation Plan for the Reform of National Vocational Education* [1] and *Opinions on Promoting the High-Quality Development of Modern Vocational Education* [2] have been issued successively, putting forward the strategic deployment of "steadily developing vocational undergraduate education and promoting the coordinated development of vocational education and general education". As a key link in the upgrading of the vocational education system, vocational college upgrading to undergraduate education aims to open up the growth channel for technical and skilled talents, and cultivate high-level application-oriented talents with a solid professional foundation, strong practical ability, and certain innovative capacity. As an interdisciplinary subject covering engineering technology and management science, the talent cultivation of the Engineering Management major needs to rely on the advantage of skill training in vocational education and possess the characteristics of comprehensive competence cultivation in undergraduate education, making it one of the key fields of vocational college upgrading reform.

1.2. Research significance

From the perspective of industrial demand, with the advancement of strategies such as new infrastructure construction and green building development, the demand for talents in the engineering management industry has shifted from traditional skilled personnel to compound talents with comprehensive capabilities including integrated project planning, whole-process management and interdisciplinary collaboration. Against the background of vocational colleges upgrading to undergraduate education, the Engineering Management major needs to realize an effective connection between skill cultivation at the vocational college stage and comprehensive competence cultivation at the undergraduate stage. As a core link connecting theory and practice and linking vocational and undergraduate training, the integration quality of practical teaching directly determines whether talent cultivation meets industrial requirements.

From the perspective of teaching practice, the current practical teaching in the process of vocational colleges upgrading to undergraduate education generally presents a fragmented situation. Vocational colleges focus on single skill training while undergraduate colleges emphasize theoretical application. There is a lack of effective coordination in objectives, contents and resources, resulting in disconnection between skills and theories and slow improvement of students' comprehensive abilities. Therefore, exploring the integrated path of practical teaching to realize a smooth transition from vocational college skills to undergraduate comprehensive abilities can not only perfect the talent cultivation system of the Engineering Management major in vocational college upgrading, but also provide a reference model for the connection between vocational college and undergraduate education of other engineering majors, which bears important theoretical and practical significance.

2. Current situation and core problems of integrated practical teaching of engineering management major — based on investigation and analysis of multiple colleges

2.1. Overview of the investigation

To accurately grasp the current situation of integrated practical teaching of the Engineering Management major under vocational college upgrading, this paper selects 12 pilot colleges offering this major (6 vocational

colleges and 6 undergraduate colleges) as research objects, and carries out research via questionnaires, teacher interviews, and teaching document analysis. A total of 180 teacher questionnaires were distributed and 162 valid ones were recovered, with an effective recovery rate of 90%; 800 student questionnaires were distributed and 735 valid ones were recovered, with an effective recovery rate of 91.88%; 45 teachers from vocational and undergraduate colleges and 20 industrial enterprise experts were interviewed.

2.2. Current situation of integrated practical teaching

According to the survey results, most pilot colleges have realized the importance of integrated practical teaching and carried out preliminary exploration. For example, some colleges have established a mutual recognition mechanism of vocational and undergraduate course credits, allowing students to identify partial practical course credits obtained in vocational colleges as basic practical credits at the undergraduate stage; some colleges have co-built practical training bases with industrial enterprises to provide unified practical platforms for vocational and undergraduate students. However, overall, the integration of practical teaching is still in the primary stage with insufficient depth and breadth, and a systematic integrated system has not yet been formed.

2.3. Analysis of core problems

(1) Vague objective positioning and disjointed competence progression

The survey shows that 45.68% of teachers regard "unclear objective positioning at vocational and undergraduate stages" as the core problem of integrated practical teaching. Practical teaching at vocational colleges centers on meeting post-skill standards with single and specific objectives [3]; while undergraduate practical teaching stresses comprehensive abilities without fully considering students' vocational skill foundation, leading to disconnection between two-stage objectives.

(2) Fragmented content system and insufficient connection

Analysis of teaching documents reveals that 62.35% of colleges suffer from fragmented practical teaching contents. Practical training at vocational colleges mainly focuses on single-post skills such as steel bar binding and engineering document sorting without full coverage of the whole engineering management process; undergraduate practical teaching involves whole-project management yet mostly relies on theoretical simulation and lacks effective connection with skill training in vocational colleges.

(3) Rigid teaching modes and lack of coordination

At both vocational and undergraduate stages, practical teaching is mainly led by colleges. Vocational colleges adopt the mode of teacher demonstration plus student imitation for skill training, while undergraduate colleges apply case analysis and simulated practical training. No collaborative linkage exists between the two modes.

(4) Scattered resource allocation and insufficient sharing

Practical teaching resources of vocational and undergraduate colleges are obviously separated. Vocational colleges possess complete skill training venues and equipment but lack scientific research resources and high-level teachers [4]; undergraduate colleges own high-quality scientific research resources and senior teachers yet have insufficient skill training facilities. Due to the absence of effective resource sharing mechanisms, complementary advantages cannot be realized, resulting in simultaneous waste and shortage of practical teaching resources.

(5) Single evaluation mechanism and biased orientation

The evaluation system of practical teaching is overly simplistic. Vocational colleges take skill attainment

as the core standard and adopt practical operation plus result evaluation, ignoring assessment of the learning process and competence progress; undergraduate colleges introduce process evaluation but still prioritize theoretical exams and report writing, with insufficient evaluation of students' practical skill application and comprehensive competence improvement [5].

3. Construction of integrated practical teaching path for engineering management major under vocational college upgrading to undergraduate education

3.1. Reconstruct gradated practical teaching objective system to clarify progressive competence orientation

(1) Centered on "consolidating vocational college skills and upgrading undergraduate comprehensive competence", a four-level gradated practical teaching objective system is constructed, including basic skill objectives, core skill objectives, comprehensive competence objectives and innovative competence objectives, to clarify training priorities and connection points of each stage.

(2) Vocational college stage (Basic skill objectives): Focus on cultivating basic post skills of engineering management, set core objectives such as engineering surveying, cost software application, construction technology operation, and engineering document sorting to equip students with solid basic skills and lay a foundation for comprehensive competence cultivation at the undergraduate stage.

(3) Undergraduate stage (Core skill integration + comprehensive competence + innovative competence objectives): On the basis of consolidated basic skills, prioritize cultivating students' integrated application ability of core skills [6], such as whole-process engineering cost control, collaborative management of project progress and quality, and settlement of engineering contract disputes.

3.2. Optimize progressive practical teaching content modules to strengthen connection between vocational and undergraduate education

Guided by the graded objective system, break the barrier of practical teaching contents between vocational and undergraduate stages, and build progressive content modules covering basic skill training, professional core skill integration, comprehensive practical application and innovative practice improvement to realize organic content integration.

(1) Basic skill training module (Vocational college-led, connected with undergraduate education)

This module covers basic skill training including engineering surveying practice, building material inspection, basic application of cost software and construction technology operation. Vocational colleges complete core skill training, while undergraduate colleges consolidate skill proficiency and standardization through skill review and advanced training, and supplement theoretical foundations of skill application to realize the connection between basic skills and theories [7]. For instance, vocational colleges deliver basic training of Glodon software, and undergraduate colleges carry out integrated training of advanced Glodon application and engineering cost analysis.

(2) Professional core skill integration module (Undergraduate-led, connected with vocational college foundation):

Centered on integrated application of core post skills, this module covers whole-process engineering cost control, collaborative management of project schedule and quality, engineering contract management and claims. Single skills learned in vocational colleges are integrated to design comprehensive practical

projects requiring students to apply multiple skills in real engineering scenarios. For example, design a whole-process cost management project of a residential building, requiring students to integrate vocational cost and construction skills with undergraduate financial analysis and contract management abilities to complete full-cycle cost estimation from pre-project planning to completion settlement [8].

(3) Comprehensive practical application module (Co-built by colleges and enterprises)

Rely on school-enterprise co-constructed practical training bases and introduce real engineering projects to carry out whole-process engineering management practice [9]. This module covers project planning, bidding management, construction process control, completion acceptance, and other full-cycle content. Students participate in projects in teams to cultivate teamwork, communication coordination and problem-solving capabilities. For example, cooperate with construction enterprises to involve students in real construction management: vocational students are responsible for on-site technical supervision and document sorting, while undergraduates take charge of collaborative management of project schedule, quality and cost to realize complementary practice and competence [10].

(4) Innovative practice improvement module (Undergraduate-led, integrated with scientific research)

Rely on scientific research and innovation platforms of undergraduate colleges, introduce cutting-edge industrial contents such as green building and intelligent construction to launch innovative practical training. For example, design innovative projects including optimization of intelligent construction site management system and energy-saving scheme design of green buildings, combining BIM technology and big data analysis to guide students to apply knowledge and skills to solve cutting-edge industrial problems and develop innovative thinking and capacity [11].

3.3. Innovate collaborative practical teaching modes to improve teaching effectiveness

Break the barrier of practical teaching modes between vocational and undergraduate colleges, and build diversified teaching modes featuring vocational-undergraduate collaboration, school-enterprise collaboration and project-driven learning to realize organic integration of teaching procedures.

(1) Vocational-undergraduate collaborative teaching mode

Establish a joint teaching mechanism for teachers from vocational and undergraduate colleges. Vocational teachers guide skill training while undergraduate teachers offer tutoring on theoretical application and comprehensive competence cultivation. For example, in the practical course of engineering cost management, vocational teachers instruct software operation skills while undergraduate teachers deliver lectures on cost analysis and financial risk control, realizing coordinated advancement of skill training and theoretical application. Meanwhile, carry out one-on-one paired practical activities between undergraduate and vocational students, enabling undergraduates to lead vocational students to participate in comprehensive projects for coordinated competence improvement [12].

(2) School-enterprise collaborative teaching mode

Deepen school-enterprise cooperation and build an enterprise-demand-oriented practical teaching mode. On the one hand, invite enterprise technical backbones to participate in practical teaching scheme design and integrate real enterprise projects and post requirements into teaching contents; on the other hand, establish enterprise internship bases and arrange internships: vocational students are assigned to basic posts focusing on skill accumulation, while undergraduates take management posts to improve comprehensive capabilities, realizing progressive cultivation from post skills to management abilities.

(3) Project-driven teaching mode

Take real engineering projects as carriers running through the whole practical teaching process [13]. Vocational colleges adopt small and simple projects for single skill training such as cost estimation of small store decoration projects; undergraduate colleges take large and complex projects to cultivate comprehensive and innovative abilities such as whole-cycle management of green residential projects. Project-driven learning guides students to apply skills and theories to practical work actively, transforming passive learning into active inquiry and boosting practical teaching efficiency [14].

5. Conclusion and prospect

5.1. Conclusion

The integration of practical teaching for the Engineering Management major under vocational college upgrading to undergraduate education is the key path to realize the transition from vocational skill mastery to undergraduate comprehensive competence. Current integrated practical teaching faces core problems including vague objective positioning, fragmented content system, rigid teaching modes, scattered resource allocation and single evaluation mechanism. Reconstructing a graded practical teaching objective system, optimizing progressive practical content modules [15], innovating collaborative teaching modes, co-building shared practical resource platforms, and improving diversified evaluation mechanisms can effectively solve the above problems, realize organic integration of vocational and undergraduate practical teaching, and upgrade talent cultivation quality.

5.2. Prospect

In the future, the integrated practical teaching of Engineering Management major can be further deepened in four aspects: first, strengthen the application of digital technology, build virtual simulation practical platforms to realize in-depth integration of online and offline training and break time-space restrictions; second, deepen industry-education integration and co-build industrial colleges with enterprises to fully introduce real projects into teaching and enhance pertinence and effectiveness; third, strengthen international exchanges and learn advanced experience of vocational and undergraduate connection from foreign education systems to optimize the integrated teaching system; fourth, carry out long-term follow-up research and dynamically adjust integrated paths according to industrial development and students' growth rules to ensure talents continuously meet industrial demands.

Disclosure statement

The authors declare no conflict of interest.

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