

Research and Practice on the Integration of Vocational Education and Skills Training through the Integration of Documentary Evidence

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Abstract: The integration of academic credentials is the core of the 1+X certificate system vigorously promoted by the country. Through the integration of academic credentials, vocational education and skills training can be practiced, which is a widely researched and explored topic in vocational colleges recently. This article explores the path and measures for the horizontal integration of vocational education and skills training from three levels: talent cultivation plan, curriculum standards, and teaching reconstruction and design. Through the integration of job courses, a professional curriculum system is constructed, and the curriculum standards directly benchmark the vocational skills standards to cultivate students' vocational skills. Industry standards and national norms are fully integrated into professional curriculum teaching to achieve measures such as "what you learn is what you use." The vocational skills training of road and bridge majors is effectively integrated into daily vocational education, and through the implementation of vocational skills training and appraisal, the integration results are strengthened and tested, forming a set of integration models that can be implemented and evaluated from top to bottom, from coarse to fine.

Keywords: Vocational education; Integration of documentary evidence; Curriculum standards

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1. Introduction

In 2022, the Vocational Education Law was promulgated, which for the first time proposed that "vocational education is equally important as general education" and aimed to establish a modern vocational education system that integrates vocational education with general education, industry and education, academic credentials, and vertical integration.

The current vocational colleges generally carry out a combination of academic education and vocational skills training mode, which integrates knowledge and practice. Students can start working immediately after graduation and quickly complete the transformation from students to technicians. Prior to this, in 2019, the Ministry of Education launched a pilot program for the 1+X certificate system in universities, which is a

major initiative by the Ministry of Education to integrate academic education and vocational skills training. Prior to this, many vocational colleges implemented a dual certification system, namely “diploma certificate + vocational qualification certificate,” which was also an exploration of integrating vocational education and vocational training.

In this context, some research has been conducted in domestic universities on how vocational education and skills training can be highly integrated and effectively connected. Wang focused on exploring the elements required for vocational skills training in higher vocational colleges, such as teaching staff, training bases, training programs, course resources, and quality evaluation. She believed that combining them with vocational training can save resources ^[1]. Lu studied the connection between vocational education and vocational skills training in vocational colleges, and explored the existing problems in the connection process, combined with the practical experience of relevant colleges, in order to achieve an effective connection between the two ^[2]. Li studied the logical relationship between vocational education and vocational training, analyzed from the perspectives of policy, practice, and market demand, explored the feasibility of their integrated development, and proposed specific strategies for the integrated development of vocational education and vocational training systems in vocational colleges based on different levels of vocational colleges, government, and students ^[3]. Taking numerical control technology as an example, Niu and Wang studied the relationship between vocational skill appraisal and higher vocational education, explored the ways and measures to integrate professional courses with vocational skill appraisal, and constructed courses that integrate courses and certificates to effectively combine teaching content with vocational skill appraisal and improve students’ professional competence ^[4].

2. Integration of talent development plan with industry job requirements: Top-level design

The talent cultivation plan is a normative document for schools to implement the overall requirements of the Party and the state for talent cultivation, organize teaching activities, and arrange teaching tasks. Its core goal is to achieve dynamic adaptation between talent cultivation and the needs of economic and social development by deepening education and teaching reforms and building a high-quality talent cultivation system that closely follows technological and industrial changes and highlights practical abilities and innovative spirit. The integration of vocational education and vocational training requires a talent development plan as the first step.

The road and bridge major is based on the transportation civil engineering industry, and its talent training program must respond to the development needs of the transportation civil engineering industry. To achieve this goal, building a professional curriculum system that perfectly meets the job requirements is of utmost importance.

2.1. Industry job analysis

The transportation civil engineering industry mainly focuses on the planning, design, construction, supervision, and operation of highways, railways, bridges, tunnels, and urban transportation infrastructure. The core positions can be divided into six directions: design planning, construction management, supervision and testing, operation and maintenance, smart transportation, and government management.

For vocational college graduates majoring in road and bridge engineering with a college degree, their

employment mainly targets the front line of transportation infrastructure construction, engaging in positions such as construction, testing, supervision, cost, maintenance, and management. As for positions such as design and planning, intelligent transportation, etc., which require higher educational qualifications, they usually need a bachelor's degree or even higher to meet the requirements.

At present, the most popular direction for graduates in the industry is construction-related positions, including construction workers, surveyors, BIM technicians, safety officers, quality officers, and document clerks. They are responsible for on-site layout, process control, technical disclosure, and data archiving. Looking at the employment destinations of graduates in recent years, they account for more than half of the total.

The second largest category of employment for graduates is in the field of testing and experimentation, namely testing and inspection personnel and non-destructive testing personnel, who carry out material and structural testing in third-party testing institutions or construction enterprise central laboratories.

In addition, there are cost and bidding positions that lean towards engineering economics, such as budgeters and cost estimators, engaged in the preparation of engineering quantity lists, cost control, and the production of bidding documents.

The above positions are mainly aimed at analyzing the employment destinations of graduates for the first time. After accumulating 3–5 years of work experience, they can be promoted to project management and comprehensive positions, gradually developing into project technical leaders or project managers, site laboratory directors, and other positions.

2.2. Integration of job and course to build a professional curriculum system

The core logic of the professional curriculum system usually follows the internal mechanism of “ability-oriented, industry-oriented, knowledge progressive, and student-centered,” which is manifested in reverse design starting from job ability requirements, organizing content with professional action logic, hierarchical advancement based on cognitive and ability development laws, and integrating moral and technical education with sustainable growth values.

Academic education emphasizes the progressive learning of theoretical knowledge, following the logic of knowledge and cognitive progression. Vertically, it is a learning progression of “general knowledge foundation → professional core → comprehensive practice → innovative expansion”; Vocational education tends to be more systematic in vocational engineering tasks, striving to build the entire competency system based on the process flow and tasks.

Therefore, in order to integrate the two in the construction of the curriculum system, the vertical axis is based on the progression of knowledge theory, and the horizontal axis breaks down theoretical barriers, promoting the integration of “theory-technology literacy.” On the basis of theoretical learning, it closely connects with the industrial chain and job groups, fully cultivates students' vocational abilities and literacy, reflects the integration of “job curriculum,” and ensures the perfect integration of theory and practice.

Based on the above analysis, a professional core course group consisting of seven courses, including “Road Construction Technology,” has been constructed. This course group not only covers the theoretical system of applied knowledge in road and bridge engineering, but also perfectly integrates the functions and needs of industry positions. The connection between professional core courses and positions is shown in **Table 1**.

Table 1. Correlation between professional core courses and job positions

	Technical position	Engineer position	Integrated courses
Construction Technology Category	Construction worker, surveyor, safety officer, materials clerk, etc.	Project manager—Constructor	Road construction technology; Bridge and culvert construction technology; Tunnel construction technology; Road and bridge construction organization design
Cost Category	Budget estimator	Cost manager, consulting engineer—Cost engineer	Engineering measurement and valuation
Testing Category	Assistant testing technician	Laboratory director, testing project leader—Testing engineer	Road and bridge engineering testing and reinforcement
New Technology Category	BIM modeler (Level 1, Level 2)		Road and bridge engineering BIM technology

3. Integration of curriculum standards and vocational skills standards: Mid-level design

Curriculum standards are guiding documents formulated by vocational colleges based on professional talent training plans, which standardize the teaching objectives, content, implementation, and assessment of a course. They are the core basis for organizing the teaching of a course. Vocational skill standards refer to the standardized requirements of a country or industry for specific job types or positions, such as the “Building Information Modeling (BIM) Skill Level Standards” (T/SCGS 311001-2019) developed by the Chinese Society of Graphic Design for BIM modelers.

3.1. Curriculum restructuring and integration with vocational skill level standards

The integration of curriculum standards with vocational skill standards refers to the systematic integration of the vocational ability requirements (i.e., vocational skill standards) required for industry positions into the goals, content, implementation, and evaluation process of vocational education courses, achieving the integration of courses and certificates, and ensuring that teaching and industry needs resonate with each other.

Traditional curriculum standards are usually formulated based on the textbooks used in the course. Especially when establishing a curriculum knowledge system graph, the theoretical framework of knowledge is mostly constructed based on the chapters of the textbook, which is often disconnected from the professional abilities and skills that the curriculum needs to cultivate, emphasizing theory over practicality.

By embedding the skill certificate level standards corresponding to the courses into the course standards, reconstructing the courses, replacing traditional practical training with real production projects, and replacing some academic evaluations with vocational skill assessments, the core is to promote mutual recognition and interoperability between the courses and the corresponding “vocational skill level certificates,” fully reflecting the “alignment between course content and vocational standards” clearly proposed by the Ministry of Education.

3.2. Curriculum restructuring and integration with vocational qualification certificate examination content

In the curriculum system, some courses have directly corresponding vocational skill standards, such as the “Engineering Surveying” course, which has a specialized measurement skill level for engineering surveyors,

which is the 2019 version of the “Engineering Surveyor Standards” by the Ministry of Human Resources and Social Security. BIM modelers also have corresponding modeling skill level standards.

However, most job positions do not have clear skill standards, such as the core professional courses “Road Construction Technology” and “Bridge and Culvert Engineering Construction Technology,” which systematically teach the construction process, methods, quality control, and standardized application of roads and bridges, focusing on the cultivation of practical abilities. They are essential professional skills for future road and bridge construction project workers, safety officers, supervisors, and other positions.

The qualification examination for the eight major categories of construction personnel, including construction workers, is an important exam for local housing and construction departments to train and select technical personnel in the civil engineering industry. Its examination content covers the requirements for professional abilities of various technical positions. By integrating it into the curriculum standards of the corresponding courses, students can seamlessly transition to the on-the-job training and assessment organized by the housing and construction department, killing two birds with one stone.

The Road and Bridge major integrates course standards with skill certificate level standards or qualification exams. Essentially, it is guided by job tasks and work processes, reconstructing course objectives and content to enable students to apply what they have learned. Upon graduation, students can not only meet the academic requirements at the vocational level, but also obtain corresponding vocational skill certifications, fully reflecting the vocational education spirit guided by skill development.

4. Integration of industry standards and specifications into curriculum teaching: Grassroots design

Integrating industry standards and national regulations into curriculum teaching is a key step in implementing the integration of academic and vocational education.

The road and bridge major has a complete standard system of survey, design, construction, and testing. According to incomplete statistics, there are hundreds of these standards and regulations, which are constantly updated. They are the highest standards that all road and bridge industry practitioners must follow in their daily operations.

In daily course teaching, textbooks are the most important learning materials for students to learn the course. However, most textbooks are not integrated with engineering and focus on the explanation of theoretical knowledge. Some textbooks, although compiled with reference to relevant standards, have shallow knowledge and weak practicality. For example, in the course of “Tunnel Engineering Construction Technology,” both the highway tunnel design specifications and the railway tunnel design specifications have rock classification content, and the classification methods are generally the same, with slight differences in details. Some textbooks do not even specify which specification is applied, resulting in many teaching materials explaining this difficult and important content differently, causing great difficulties for students’ learning. In addition, some textbooks have not been revised in a timely manner, and when the new version of the standards has been implemented nationwide, the textbooks still refer to the old version of the standards, resulting in some mandatory technical requirements that are inconsistent with the standards, which can easily mislead students. Therefore, corresponding normative standards should be integrated into the teaching process.

In specific implementation, the program of teaching content reconstruction → standardized stripe embedding → engineering case application can be adopted.

When reconstructing teaching content, for practical content, it is possible to follow the sequence and flow of the process, embedding the normative requirements of each process link, so that students not only understand the link but also the quality and safety regulatory requirements of this link. In the teaching process, virtual simulation systems can be used to simulate processes. If this practical training condition is not available, project-based teaching and case-based teaching can also be adopted. Real engineering cases can be applied to integrate the process flow and regulatory requirements into the cases, learning while applying, and applying what is learned.

Fully integrating the national standards of the road and bridge industry into teaching ensures the accuracy of students' knowledge and skills. By embedding standardized technical regulations and safety requirements into course teaching content, establishing work scenarios for engineering projects, allowing students to be present at the work site, face the process directly, accurately control the key requirements of the process, and make the knowledge and theory learned by students come alive and directly apply to project practice; On the other hand, by directly approaching the reality of work, students can fully recognize the important role of standardized standards in the field of road and bridge engineering, and cultivate their professional competence in standardized homework.

5. Integration effect evaluation: Vocational skill appraisal

Vocational skill appraisal has been implemented in vocational colleges since the beginning of the new century. In addition to vocational education, specialized skill training is provided to students, and vocational skill level certificates are issued through assessment and evaluation. Upon graduation, students hold both a diploma and a skill level certificate. The “integration of certificates and credentials” promoted by the Ministry of Education is a continuation and strengthening of this system.

There are many professional certificates in the field of road and bridge engineering, including certificates such as the Eight Major Construction Personnel, as well as skill-level certificates such as BIM modeler and surveyor. By integrating the assessment and skill requirements of these certificates into the professional curriculum system through job course integration, relevant professional courses are offered, and vocational skills training is conducted simultaneously with academic education.

Due to the fact that some certificates, such as construction worker assessments, involve multiple courses with strong comprehensiveness and wide coverage, they often require specialized training and reinforcement to achieve complete integration. Targeted training can integrate numerous knowledge and skills, form complete professional abilities, and cultivate students' ability to comprehensively solve engineering problems. For example, writing a construction plan for a roadbed project requires learning from multiple courses such as road construction, project management, and roadbed inspection.

Skill appraisal and assessment is currently the most direct, effective, and feasible way to evaluate the effectiveness of document evidence integration. Students majoring in road and bridge engineering can effectively evaluate their learning effectiveness and skill level by participating in the Eight Major Construction Personnel Examination and Surveying Skills Appraisal, which is a direct reflection of the integration effect. In addition, obtaining a certificate through assessment is also one of the purposes of

integrating documentary evidence.

In the talent training program, a system of mutual recognition of courses and certificate credits, known as “course certificate integration,” has been implemented. Construction worker job certificates and intermediate surveying skills certificates, which are in high demand in the industry, have been selected from many vocational certificates. Organize students to participate in the construction worker assessment in Chongqing in the fourth semester, and provide targeted pre-exam training before the assessment. Students who pass the construction worker assessment can apply for exemption from four core professional courses that integrate the assessment content, including “Road Construction Technology,” and directly obtain corresponding credits for the courses. In the fifth semester, organize students to participate in the intermediate surveying skills level assessment in Chongqing, and apply for exemption from the “Engineering Surveying” course if they pass the exam. The system of mutual recognition of course and certificate credits greatly enhances students’ enthusiasm for learning. Vocational skill appraisal not only allows students to obtain vocational certificates, but also provides a comprehensive evaluation of the integration effect of vocational education and vocational training.

6. Conclusion

The integration of vocational education and skills training is the development trend of higher vocational colleges, and the use of documentary evidence integration is currently the best way to practice this concept. By integrating industry job requirements into top-level talent training programs, vocational skill level standards and assessment content into middle-level curriculum standards, and integrating norms and practical skills requirements into grassroots curriculum reconstruction and design, this integration is not just a simple combination of academic education and certificate training, but a step-by-step breakdown and refinement of vocational skills into every aspect of vocational education, ultimately achieving a “zero distance” connection between technical skill talent training and industry employment standards. The vocational skill appraisal and various certificate exams widely carried out in vocational colleges can be used as a comprehensive evaluation indicator to measure the integration effect.

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