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Exploration and Practice of Transforming Pilot-Scale R&D Achievements into Teaching Projects in Higher Vocational Colleges

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Abstract

Under the policy orientation of the high-end and intelligent transformation of the manufacturing industry and the integration of production and education, pilot-scale R&D achievements, as key intermediate products of technology industrialization, possess both technological innovation and practical applicability, which are highly consistent with the training objectives for technical and skilled talents in higher vocational colleges. Based on literature research and practical exploration, this paper sorts out the core value and existing dilemmas of transforming pilot-scale achievements, constructs a full-chain transformation path including three-dimensional screening, four-step reconstruction, school-enterprise collaboration, and multi-dimensional evaluation, and verifies the feasibility of the path with cases in fields such as industrial robots, intelligent production lines, and digital twins. The research shows that this transformation mode can effectively solve the problems of backward teaching resources and disconnection between production and education in higher vocational education, providing practical reference for improving talent training quality and deepening school-enterprise cooperation.

Keywords

Pilot-scale R&D Achievements, Higher Vocational Teaching, Integration of Production and Education, Achievement Transformation, Teaching Projects

1. Introduction

Currently, the demand for innovative and applied technical and skilled talents is becoming increasingly urgent with China's industrial transformation and upgrading. As the main position for talent training, higher vocational colleges are facing prominent problems in traditional teaching, such as backward resource renewal, training scenarios divorced from industrial reality, and disconnection between talent training and enterprise needs. The integration of production and education is the core path for the high-quality development of higher vocational education, and pilot-scale trials, as a key bridge for technology industrialization, are gradually becoming an important carrier for school-enterprise collaborative talent training. Pilot-scale R&D achievements are phased results formed by enterprises in the process of technology industrialization, covering practical content such as process schemes, equipment operation specifications, and problem-solving solutions. Compared with mature industrialized technologies, the trial-and-error processes and optimization ideas contained in them are more conducive to cultivating students' innovative thinking and complex problem-solving abilities.

Existing research has yielded diverse exploration results. Liu et al. (2025) pointed out that the construction of pilot-scale workshops provides an effective starting point for the integration of production and education, realizing the organic combination of curriculum construction, skill training, and innovative ability cultivation in the food inspection and testing major; Wang et al. (2025) took the new energy vehicle industry as the research object, constructed a clustered system of pilot-scale project courses and a "five-stage progressive" training mode, improving the adaptability between talents and industrial positions; Duan et al. (2024) pointed out that the current transformation of scientific research achievements is faced with dilemmas such as insufficient awareness of educational value and inadequate school-enterprise cooperation. However, there is still a lack of special research on the transformation of pilot-scale achievements, and there is no systematic path adapting to their technical characteristics and teaching needs. Therefore, exploring the transformation mechanism of pilot-scale R&D achievements into higher vocational teaching projects is of great practical significance for promoting the teaching reform of higher vocational education and serving the high-quality development of the industry.

2. Core Value and Theoretical Support of Transforming Pilot-Scale Achievements

2.1 Core Value

Transforming pilot-scale achievements into teaching projects can, first, enrich the types of teaching resources, build a dynamically updated resource library, and break the limitations of traditional textbooks being static and backward (Mao, 2019); second, innovate teaching modes, realize the practical implementation of "teaching as R&D" (Zhang, Yu, & Qin, 2024), and promote teachers' transformation from skill instructors to R&D-oriented educators; third, accurately connect with industrial needs and cultivate students' innovative and practical abilities, as guiding students with scientific research projects is an effective way to cultivate the innovative ability of higher vocational

students (Deng & Qiao, 2020). At the same time, the transformation process can promote the transformation of school-enterprise cooperation from superficial cooperation to symbiotic development, realize resource sharing and win-win interests, and implement the core requirements of the integration of production and education.

2.2 Theoretical Support and Practical Foundation

Constructivist learning theory emphasizes the active construction of knowledge in real scenarios, and the simulated R&D scenarios formed by the transformation of pilot-scale achievements are highly consistent with the situational and active requirements of this theory; the theory of integration of production and education provides a cooperative logic for the transformation, realizing collaborative development through two-way empowerment between schools and enterprises. Regarding the teaching application of pilot-scale achievements, some studies have explored characteristic modes: Li (2020) proposed the "on-site research environment" mode, integrating scientific research achievements into teaching through the processes of research environment creation, process implementation, and achievement transformation; Mo et al. (2024) proposed constructing an internal circulation system for resource transformation combined with the "post-course-competition-certificate" scheme, which all provide practical reference for the transformation of pilot-scale achievements. The growth law of technical and skilled talents guides that the transformation should design gradient tasks to match the ability development stages of students' basic skills, comprehensive application, and innovative improvement.

3. Existing Dilemmas in the Transformation of Pilot-Scale Achievements

3.1 Lack of Screening Criteria and Insufficient Adaptability

Most higher vocational colleges lack a scientific achievement screening system, focusing only on technical novelty while ignoring students' cognitive levels, teaching objectives, and school resource conditions. As a result, some transformed projects are either too difficult or too simple in terms of technology, making it impossible to achieve in-depth teaching.

3.2 Vague Transformation Path and Lack of Systematic Design

Pilot-scale achievements focus on technical realization, while teaching projects are oriented towards ability cultivation, with significant logical differences between the two. Currently, most transformations directly copy the pilot-scale process without teaching-oriented reconstruction, leading to a lack of hierarchy in teaching content (Yang & Sun, 2018) and poor adaptability.

3.3 Imperfect Collaboration Mechanism and Insufficient Transformation Motivation

School-enterprise cooperation mostly remains at a superficial stage. Enterprises are worried about technology leakage and imbalance between input and output, resulting in low participation enthusiasm; schools lack targeted incentive policies (Zha, 2024), teachers' transformation workload is not included in assessments, and there is insufficient funding and resource support, making it difficult to form a cross-border collaborative research matrix (Hong & Lei, 2025).

3.4 Incomplete Evaluation System and Difficulty in Measuring Effects

Evaluation still focuses on traditional indicators such as operational standardization and task completion rate, ignoring the assessment of innovative ability and problem-solving ability; no school-enterprise joint evaluation mechanism has been established, making it impossible to accurately judge the adaptability of teaching projects to industrial needs (Liu, 2025).

4. Practical Path of Transforming Pilot-Scale Achievements

The transformation of pilot-scale R&D achievements into higher vocational teaching projects requires building a full-chain practical system including precise screening, systematic reconstruction, in-depth collaboration, and scientific evaluation. This system aims to solve the problems of adaptability, process, collaboration, and effectiveness in the transformation process, ensuring that the achievements are in line with both teaching laws and industrial needs.

4.1 Establish Three-Dimensional Screening Criteria to Precisely Select Suitable Achievements

Precise screening is the prerequisite for transformation, and a three-dimensional standard including technical adaptability, teaching adaptability, and resource adaptability needs to be established. In terms of technical adaptability, priority should be given to achievements with difficulty between basic operations and core R&D that meet professional training objectives, such as “pilot-scale application and commissioning of industrial robots” and “pilot-scale layout optimization of intelligent production lines” in intelligent manufacturing majors. These achievements not only meet the needs of skill improvement but also avoid the impact of overly difficult or simple technology on teaching effects. In terms of teaching adaptability, it is necessary to ensure that achievements can be decomposed into independent and related knowledge points, and gradient tasks can be designed. For example, “pilot-scale production line modeling based on digital twins” can be decomposed into knowledge points such as 3D modeling, data mapping, and error calibration, corresponding to three-level tasks: basic modeling, advanced commissioning, and comprehensive optimization. Resource adaptability needs to be connected with the school’s existing conditions. If the school is equipped with industrial robot training platforms and digital twin simulation platforms, relevant achievements can be prioritized for transformation, and the shortage of teachers or equipment can be compensated through enterprise technical guidance.

4.2 Construct a Four-Step Transformation Process to Realize Teaching-Oriented Reconstruction of Achievements

First, achievement decomposition: schools and enterprises jointly decompose pilot-scale achievements into four modules: technical principles, operation processes, problem cases, and optimization schemes; second, teaching reconstruction: reorganize into theoretical teaching units and practical training units in combination with students’ cognitive laws; third, task design: build gradient practical training tasks including basic, advanced, and comprehensive levels; fourth, effect verification: collect feedback through pilot teaching and dynamically optimize teaching content and design.

4.3 Improve the School-Enterprise Collaboration Mechanism to Ensure the Sustainable Progress of Transformation

Jointly establish a teaching transformation center for pilot-scale achievements, where enterprises send engineers to provide technical guidance, schools select teachers to be responsible for teaching implementation, and set up a special fund shared by schools and enterprises; formulate two-way incentive policies, include teachers' transformation work in performance assessments, and provide salary subsidies and promotion opportunities for enterprise participants; sign confidentiality and profit distribution agreements to protect the legitimate rights and interests of both schools and enterprises and prevent the risk of technology leakage.

4.4 Establish a Multi-Dimensional Evaluation System to Precisely Measure Transformation Effects

For the evaluation of students' abilities, a combination of process-oriented and summative evaluation modes is adopted. The process focuses on collaboration and innovation, while the summative evaluation uses simulated pilot-scale task assessments with joint scoring by schools and enterprises; teaching quality is evaluated by multiple subjects including student satisfaction, peer review, and enterprise feedback; industrial adaptability relies on a dynamic monitoring mechanism for industrial needs to ensure that teaching content keeps pace with industrial development.

5. Conclusion and Prospect

Transforming pilot-scale R&D achievements into higher vocational teaching projects is an innovative path to deepen the integration of production and education and improve the quality of talent training. This transformation mode can effectively solve the existing pain points in higher vocational teaching, promote the transformation and upgrading of the teaching system, the improvement of teachers' abilities, and the enhancement of students' skills. At the same time, it can build a good ecology of symbiotic development between schools and enterprises.

In the future, it is necessary to further expand the scope of practice and optimize the transformation path in combination with the characteristics of different professional fields; strengthen the construction of an organized scientific research system to improve teachers' transformation ability; develop virtual simulation resources with digital technology to reduce transformation costs. Through continuous exploration and improvement, pilot-scale achievements can better serve higher vocational education and provide solid talent support for industrial transformation and upgrading.

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