Practice of Digital Technology-Empowered Flipped Classroom

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Abstract. This paper explores the path of digitally-driven "Flipped Classroom" in vocational education. Under the context of developing new quality productive forces, the classroom is undergoing a transformation from experience-driven to data-driven approaches, aiming to cultivate technical and skilled talents with digital literacy, innovation capabilities, and practical competence. Theoretically, the paper explains the essence of the "Flipped Classroom", pointing out that it represents a paradigm shift from "teaching-centered" to "learning-centered" education, reflected in the dialectical integration of three dimensions: objectives, subjects, and processes, with a focus on coordinated changes in teaching subjects, models, and methods. Practically, the paper takes the "Internet of Things Technology and Application" course as an example, illustrating the implementation of precision teaching based on student digital profiles. It also describes the restructuring of teaching content, objectives, implementation approaches, and models to achieve the integration of "post-class-competition-certification." Looking ahead, the core of the "Flipped Classroom" lies in constructing a data-driven, "teaching based on learning" smart education ecosystem, transforming the classroom from a place of knowledge transmission into a practice community that fosters competency development and innovation incubation. This transformation aims to enhance the quality of talent cultivation and contribute to high-quality economic and social development.

Keywords: Flipped Classroom; Digital Technology-Empowered; Student Digital Profile; Vocational education

1 Introduction

As digital technologies like big data, AI, and cloud computing permeate all sectors, educational digitalization has become a key breakthrough for China to open new paths and build new advantages in education. The revised Vocational Education Law (2022) and related policies, such as the Opinions on Deepening Modern Vocational Education

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System Reform, have reinforced vocational education's role in serving Chinese modernization. As a vital channel for cultivating skilled talent, vocational education must now respond to the digital economy and new quality productive forces, accelerating the training of digitally literate, innovative, and practically capable professionals.

Classrooms are the core site of teaching and the focal point of educational reform. Widespread use of digital technology is transforming traditional teaching, learning, and assessment[1][2]. From resource provision to instructional design, classrooms are shifting from experience-driven to data-driven. Policies emphasize developing core courses and quality teaching resources for key industries-including next-generation IT, advanced manufacturing, and bio-medicine to enhance vocational schools' key operational capacities. In this context, digitally empowering classroom teaching and driving "Flipped Classroom" are essential for deepening modern vocational education reform, advancing reforms in teachers, materials, and methods, improving talent cultivation, and supporting high-quality socioeconomic development.

2 The Connotation of "Flipped Classroom": From Formal Change to Substantive Reconstruction

Learning in the age of disruption points out that humanity is entering a new era deeply shaped by digital technology, and that systemic transformation of educational forms has become an irreversible trend[3]. In this context, "Flipped Classroom" is no longer a localized improvement in teaching technology or instructional form; rather, it is a trans-formative practice directed toward the essence of education. Its core lies in breaking through the traditional teaching paradigm centered on knowledge transmission, establishing an outcome-based educational philosophy oriented toward the development of students' qualities and abilities, and promoting the transformation of classrooms from being teaching-centered to learning-centered.

From a dialectical perspective, the "Flipped Classroom" advances through multiple unities[4], shown in Fig. 1. First, it unites educational goals, emphasizing not only knowledge acquisition but also the holistic development of higher-order qualities such as engineering competence, transfer ability, innovation, and values. Second, it unites the roles of students and teachers: while keeping students central, it transforms teachers from mere knowledge transmitters into designers, guides, and facilitators, achieving organic integration of student agency and teacher leadership. Third, it unites theory and practice in the teaching process, where ongoing practice, reflection, and refinement in authentic contexts make instructional reform both practically relevant and sustainable.

From the perspective of teaching-element structure, the "Flipped Classroom" focuses on transforming three coordinated dimensions: teaching subjects, models, and methods, shown in Fig. 1. At the subject level, it adheres to a people-oriented approach, highlighting students' active construction of knowledge. Constructivist learning theory posits that knowledge is not merely transmitted by teachers but is built by learners through interaction and reflection in authentic contexts. By promoting autonomous, cooperative, and inquiry-based learning, the "Flipped Classroom" motivates students, taps their creative potential, and enhances teachers' professional role in supporting, guiding, and regulating the learning process,shown in Fig. 2.

Against the background of the digital economy and the computing-power revolution, society has put forward higher requirements for the digital literacy, engineering competence, and lifelong learning ability of technical and skilled talent[5]. As the form of education most closely connected with industry, vocational education places even greater emphasis in its "Flipped Classroom" on student-centeredness, the integration of new technologies, and engineering competence training, and is committed to building a new form of blended teaching based on a coherent knowledge system.

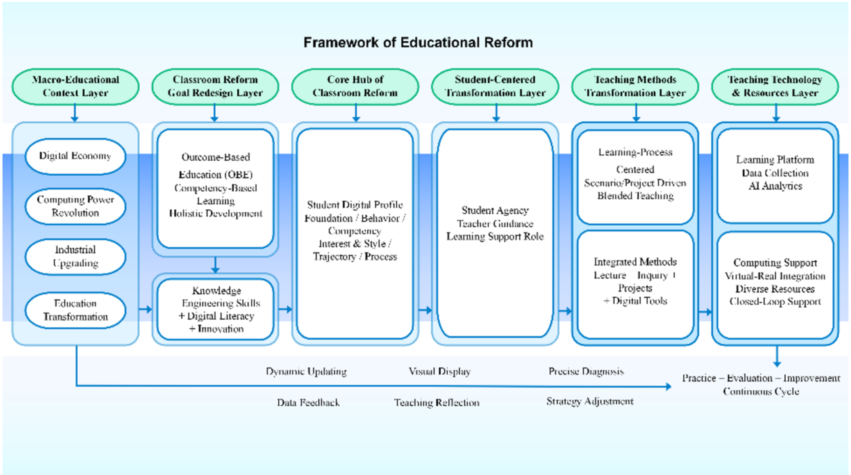

Fig. 1. Framework for Educational Reform

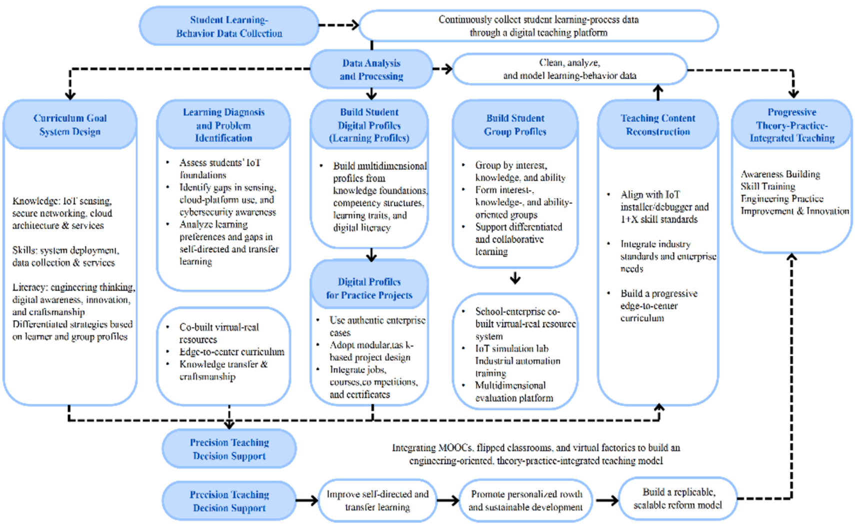

Fig. 2. Framework for implementing "Flipped Classroom"

3 Organizational Implementation Path of "Flipped Classroom": Teaching Reconstruction Based on Digital Profiles

Taking *Internet of Things Technology and Application* as a course case, this study systematically reconstructs the course teaching form on the basis of student digital profiles and explores an operable path for "Flipped Classroom"[6].

3.1 Building Learning-Condition Profiles to Support Precise Teaching Decisions

Relying on a digital teaching platform, data on students' learning behaviors throughout the entire process are collected and analyzed to construct learning-condition profiles across dimensions such as knowledge foundation, ability structure, learning characteristics, and digital literacy. The analysis indicates that students generally possess a basic understanding of the Internet of Things, but show clear weaknesses in sensor data collection, cloud platform application, and information security awareness. They prefer hands-on practice and show a relatively high acceptance of new technologies, but their autonomous learning ability and knowledge transfer ability still need to be strengthened.

On this basis, students are grouped and profiled along three dimensions: interest, knowledge, and ability. The interest group focuses on the exploration process and result orientation; the knowledge group demonstrates strong logic and prominent systematic cognitive ability; and the ability group shows strong practical competence and rich operational experience. These grouped profiles provide a data basis for implementing differentiated instruction and collaborative learning.

3.2 Clarifying Course Objectives and Focusing on Engineering Competence and Comprehensive Literacy

In accordance with occupational post standards, major standards, and course standards, and in light of the analysis of student profiles, the course objectives are systematically designed around three dimensions: knowledge, ability, and literacy. Students are expected to master foundational knowledge such as IoT perception, secure networking, cloud platform architecture, and service applications; meet the capability requirements of IoT installation and commissioning technicians in system deployment, data collection, and service application; and at the same time develop engineering thinking, digital awareness, innovative consciousness, and craftsmanship spirit, thereby achieving transferable and sustainable development.

3.3 Reconstructing Teaching Content to Integrate Post, Course, Competition, and Certification

Based on the competency requirements for IoT installation and commissioning technicians and the 1+X vocational skill level standards, the course content aligns with industry standards and real enterprise needs. Using new-form teaching materials jointly developed through school-enterprise collaboration, it builds a progressive content system advancing from the edge side to the central side. Practical projects are drawn from real enterprise production cases and are designed in modular and task-based form, thereby strengthening engineering implementation competence and realizing the integration of post, course, competition, and certification.

3.4 Innovating Teaching Implementation and Advancing the Integration of Theory and Practice

During course implementation, schools and enterprises jointly build a teaching resource system that combines the virtual and the real, develop IoT simulation experiment platforms, industrial automation training platforms, and diversified evaluation platforms, and promote the integrated operation of teaching, management, and evaluation. The teaching process is closely aligned with enterprise production process standards and adopts progressive instruction through task-driven methods, forming a teaching path of awareness cultivation - skill training - engineering practice - improvement and innovation.

3.5 Forming a Teaching Model and Enhancing Replicability

Based on big-data analysis of learning conditions and student digital profiles, the course constructs an intelligent teaching model integrating MOOCs, the flipped classroom, and the virtual factory. Through engineering-oriented integrated design of theory and practice, students are guided to realize autonomous learning, transfer learning, and personalized development while solving real problems.

4 Conclusion

The future path of the "Flipped Classroom" lies in continuously advancing the deep integration of digital technology into the entire teaching process, using data to drive instructional innovation and build a smart education ecosystem characterized by "teaching tailored to learning and individualized development"[7]. By strengthening the collaborative co-creation between teachers and students as dual subjects, deepening the dynamic alignment between curriculum content and industry needs, and refining evaluation systems that support personalized development, the classroom will transform from a site of knowledge transmission into a community of practice that fosters competency development, innovation incubation, and value formation. This shift will not only comprehensively enhance the quality and adaptability of talent cultivation in vocational institutions but also provide solid talent support and innovative momentum for high-quality economic and social development.

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