The Teaching Reform of Three Attributes, Four Orientations, Five Dimensions: A Paradigm for First-Class Course Reform in Applied Universities

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Abstract. Under the background of new quality productive forces, the curriculum construction of the application-oriented universities should focus on the adaptability and effectiveness of talent cultivation, and carry out holistic and systematic reform from three dimensions: curriculum system, teaching content design, and classroom teaching format. However, in traditional curriculum construction, the curriculum system is centered on knowledge, the teaching design is centered on textbooks, and the teaching method is centered on teachers, which can not effectively support the cultivation of high-quality talents. To address these issues, a teaching reform paradigm known as "Three Attributes, Four Orientations, and Five Dimensions" is proposed. First, a competency-based curriculum system should be reconstructed, which is characterized by three attributes, including the adaptability of course objectives, the applicability of course content, and the digital intelligence of course scenarios. Second, an outcome-oriented teaching content should be redesigned following the four orientations, including standardized graduation requirements, project-based teaching content, diversified teaching methods and pluralistic teaching evaluation. Third, a student-centered classroom teaching format should be recreated with five dimensions as the goal, including ideological and political height, content depth, interactive warmth, spatial intelligence, and outcome effectiveness.

Keywords: new quality productive forces, first-class course, competency-based, outcome-oriented, student-centered

1 Introduction

In recent years, the rapid development of new quality productive forces has become a core engine for economic and social progress. Due to their greening, informational, digital, and intelligent development, as well as innovation-driven progress, the new patterns of development arise in labor materials and labor objects demand that works should possess new quality capabilities. Therefore, universities must align their talent cultivation goals closely with the development of new quality productive forces. Such

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goals should reflect inherent characteristics, such as complex knowledge, transversal competencies, and overall quality[1].

In 2015, China's Ministry of Education released document requiring local universities should truly shift their educational philosophy toward serve local economic and social development, toward industry-education integration and school-enterprise cooperation, toward cultivating application-oriented technical and skilled talents, and toward enhancing students' abilities in employment and entrepreneurship, so that they can substantively improve their ability to serve regional economic and social development [2].

Curriculum is the foundation for talent cultivation in universities, and is the core medium for transforming new quality productive technology into new quality capabilities. In October 2019, the Ministry of Education issued the document named "Implementation Opinions on the Construction of First-Class Undergraduate Courses", proposing to develop first-class undergraduate courses that meet the requirements of the new era, bringing about excellent courses , strong teachers, engaged students, rigorous management, effective outcomes, and forming a first-class undergraduate course system with Chinese characteristics and world-class standards, and building a higher-level talent cultivation system[3], which provides an action guideline and evaluation criteria for the reform of first-class undergraduate courses under the background of new quality productive forces.

In recent years, the Ministry of Education has selected more than 18,000 national first-class undergraduate courses from universities to set an example for educational reform. Universities are driven to align the courses reform with the first-class course standards featuring high-level, innovative, and challenging content, which promotes the construction of first-class undergraduate courses to achieve remarkable results. For example, Nanjing University has implemented the "Ten-Hundred-Thousand" high-quality courses construction plan, successfully providing personalized and high-quality courses groups for different types of students, and building a first-class undergraduate curriculum system, which has become a reference model for other universities[4]. Beijing University of Posts and Telecommunications has proposed a comprehensive "four-in-one" solution for the cultivation of electronic information talents, and explored an effective curriculum construction mode suitable for its own characteristics [5]. The research of Tianjin University, aiming at the background of new engineering, has reformed the practice teaching, built a first-class curriculum practice system, and provided an innovative path for curriculum practice teaching[6]. The exploration of Heilongjiang University and Beijing Normal University in curriculum evaluation and teaching design has further enriched the implementation framework of the blended teaching and flipped classroom. These practices and researches have jointly improved the quality of higher education courses and formed diversified curriculum construction achievements [7,8].

The above cases start from different perspectives such as the construction of curriculum group (Curriculum System), curriculum construction, curriculum practice teaching construction, curriculum teaching evaluation and curriculum teaching design, which not only have the high-level systematic construction, but also have the low-level specific implementation paths. However, for Local Application-oriented

Universities, the construction of first-class courses should highlight the "application-oriented" features, focus more on the adaptability to industrial needs[9], the professionalism to job requirements[10], and the cross-border nature to the integration of production and education, and reconstruct the competency-based curriculum system, the outcome-oriented teaching design, and the student-centered classroom teaching form.

In order to implement the fundamental task of moral education, strengthen the comprehensive ability of students in their job positions, and solve the problems posed by knowledge-centered curriculum systems, textbook-centered teaching designs, and teacher-centered classroom formats, the Electronic Information Engineering major in our university has taken OBE reform. Following the philosophy of "competency-based, outcome-oriented, and student-centered," we have promoted the first-class course teaching reform named Three Attributes, Four Orientations and Five Dimensions pattern, and reconstructing a competency-based curriculum system, rebuilding outcome-oriented course teaching, reshaping effective student-centered classrooms. These efforts have yielded fruitful teaching results and achieved high-quality talent cultivation.

2 Reconstructing a Competency-based Curriculum System Characterized by the Three Attributes

Guided by industry demand and aligned with new industry standards and professional standards among government, schools, and enterprises, the OBE reform in major has established the modular curriculum based on a competency-based course matrix, updated the latest content based on new technologies, new standards, and new requirements of job positions, which reflects the higher-order nature of the talents cultivation for the major.

2.1 Building a Curriculum System Based on the Competency Matrix

First, an indicator system is developed, which aligns with the requirements of the job positions. By referencing the official undergraduate teaching standards system and combining industry talent demands and job competency requirements, the university and enterprises jointly formulate five objectives of the talent cultivation at both the school and major levels. The teaching team of major, based on the relationship matrix which reflects the extent to which graduation requirements support the objectives of the talent cultivation, further specifies the graduation requirements, namely a competency indicator system covering 12 primary professional core competencies including engineering knowledge, problem analysis, solution design, innovation application, tool utilization, engineering communication, sustainable development, professional standards, teamwork, communication, project management, and lifelong learning as well as 32 secondary core competencies.

Second, a curriculum system is reconstructed based on the competency matrix. At first, the teaching team of the major analyzes the relationship between course objec-

tives and graduation requirement, and qualitatively evaluates the extent to which each course supports the indicators of the graduation requirement, and establishes a matrix of courses supporting the graduation requirement indicators, then assigns each course a supporting level for each indicator using a three-level system: H (strong support), M (medium support), and L (weak support). Next, according to the principle of balanced support, the course weight proportions are adjusted to form a curriculum system in which each course provides balanced support for all indicators.

Third, course modules are reorganized and established, which reflect the courses are adaptable to the external demands. Using the 12 primary professional core competencies as the vertical axis and junior, intermediate, and senior job positions as the horizontal axis, and incorporating new technologies, new standards, etc., into course content, the modular course system is built where activities including competition, innovation and entrepreneurship and scientific research are transformed into teaching resources to meet students' personalized development needs.

2.2 Developing Task-Oriented Courses based on Job Requirements

First, the logical starting point is identified for curriculum development. Teachers are organized to participate in surveying the job positions, and analyze the knowledge, abilities, qualities of personnel in job positions, as well as the work elements contained in their tasks such as work objects, work environment, conditions, tools and equipment and work requirements, and at last form a typical analysis report for the job positions.

Second, the practical evidence is collected for compiling and selecting teaching content. Through practical expert seminars, professional teachers and industry practical engineers jointly develop curriculum standards based on typical job analysis reports of job positions, and form a support matrix between teaching content such as work objects, methods, tools, organizational methods, work requirements and graduation requirements.

Third, the learning task is designed to simulate real working environment. The teaching team collects several real and specific work tasks through enterprise practice, questionnaires, and face-to-face interviews. Then, according to the difficulty and teaching feasibility, the work tasks are sequenced into the learning tasks of the course.

Fourth, learning modules are suitable for customizing and flexibly combining. The teaching team selects learning content with process-oriented knowledge points which are needed to finish the sequenced learning tasks as the smallest learning units, so that the flexible combination of learning units and meet the exploratory and personalized learning needs of students with different foundations.

2.3 Building a System for Supporting Teach based on Polymorphic Integration

First, the digital learning spaces are built. Guided by personalized learning needs, the new forms of situational teaching venue such as smart teaching, virtual simulation, and innovation platforms are created to shape a teaching ecosystem that integrates

various functions such as online self-learning, online communication, real-time classroom interaction, case teaching, process-based learning assessment and comprehensive teaching evaluation activities.

Second, ubiquitous and granular learning resources are developed. Guided by digital teaching, standardization of curriculum, small classes teaching, multidimensional evaluation and flexible management, and following the project-based teaching reform concept, granular course teaching resources are developed under the deep integration of project-based teaching and information technology to empower digital teaching.

Third, the self-compiled textbooks are created. The textbooks are developed by a collaborative teaching team from schools, enterprises, and industries, which integrates textbooks, courses, and online platforms, and incorporates new technologies, new standards and typical enterprise cases from industry fields into the teaching materials, eventually forms task-driven digital textbooks.

3 Redesigning an Outcome-Oriented Teaching Method Based on the Principle of Four Orientations

Focusing on standardization, scientific rationality, and professionalism, and according to the principle of standardized graduation requirements, project-based teaching content, diversified teaching methods and pluralistic teaching evaluation, a teaching process is designed to align with target needs, work processes, technological frontiers, and competency requirements, which highlights the practicality of teaching design.

First, the design of teaching objectives are regulated according to the standardized graduation requirements. Based on a four-fold evaluation consisting of the compatible degree between job requirements and cultivation objectives, the supporting degree of graduation requirements for cultivation objectives, the adapting degree of course objectives for graduation requirements, and the achieving degree of course objectives for job requirements, and following the outcome-oriented backward design principle, a design path is established from external job requirements, graduation requirements, course objectives to unit teaching objectives in order to design the standardized and scientific teaching objectives.

Second, teaching content is constructed through the project-based organization of teaching materials. Using real enterprise products, projects, tasks, cases, processes as references, procedural knowledge is designed, which are elements of experience and strategies such as the work objects, work content, tools and equipment, organizational methods, products, and environment. Through the organic integration with declarative knowledge, the lesson plans are formed to meet the requirements of project-based teaching.

Third, the implementation of the teaching process are driven through diversified teaching methods. With the goal of cultivating students' comprehensive abilities that equally emphasize knowledge, skills, and literacy and by using teaching methods such as case teaching, task-driven learning, heuristic questioning, on-site demonstrations, comparative teaching, error detection and correction, and group discussions, the BOPPPS teaching process is designed to encourage participatory and inquiry-based

learning and to training students' thinking abilities in collaboration, design, and innovation.

Fourth, comprehensive ability assessment is reformed deeply through diversified teaching evaluations. Following the educational concept of personal holistic development, guided by a human-centered view of comprehensive ability evaluation, and based on practice-oriented work process design and project-based teaching implementation, an overall evaluation plan is designed to cover both process and outcomes, meanwhile the multi-dimensional evaluations is implemented integrating points, lines, and planes. From phased tests at midterm and final stages, student growth records before, during, and after class, to the aspects of knowledge, ability, and quality, the comprehensive evaluation is conducted, which are process-oriented and outcome-oriented, to promote continuous improvement of students' comprehensive abilities.

4 Aiming for the Five Dimensions to Reconstruct a Student-centered Classroom Form

Focusing on the ideological height, content depth, interactive warmth, spatial intelligence and outcome effectiveness of classroom teaching, the student-centered five-dimensions teaching model is created under integration of three stages of before class, during class, and after class, to highlight the effectiveness of teacher-student interaction in the classroom.

First, the in-class and extracurricular activities are integrated to create a high-level curriculum for ideological education. Focusing on the goal of cultivating students' humanistic qualities, and building a nexus between teacher and student with online and offline interactive communication, according to the learning characteristics of the three stages of before class, during class, and after class, the teaching process is implemented through task feedback and communication, appraisal of applied case designs, study of ideological cases and classroom interaction, where ideological elements such as the core socialist values, the Taizhou spirit (pioneering spirit, entrepreneurial spirit, Taizhou culture of harmony), school spirit, and professional literacy are organically integrated. As a result, an ecosystem for both in-class and extracurricular ideological education is built by the means of practicing a student-centered approach.

Second, the in-depth learning contents are developed by integrating job positions, professional competitions, professional certificates into courses. Focusing on students' high-level learning content, aiming at cultivating comprehensive job-related abilities, using learning tasks based on typical work tasks as the first level tasks, competition projects as the second level tasks, and innovation and entrepreneurship case projects as the three level tasks, the personalized learning paths are designed and flexible classroom teaching is carried out to meet the learning needs of different types of students.

Third, the warm teacher-student interactions are created by combining scaffold and accompany. Focusing on students’ role as active learners, a graduated learning support design is used to build an learning scaffold in order from high support to low

support for completing learning tasks. Teachers, as guides and companions, following the teacher-student interaction sequence of dependent learning to independent learning and through providing one-on-one guidance, heuristic questioning, group discussions, peer evaluations and other interactive supports, motivate students' learning initiative and proactive, which ultimately cultivates their ability to independently and effectively complete learning tasks based on real scenarios and undertake actual work.

Fourth, an intelligent learning space is created through online-offline integration. Focusing on the ubiquitous learning needs of students, on the one hand, authentic learning environment such as practical platforms, innovation and entrepreneurship centers and experimental research are established offline. on the other hand, Superstar Online Courses and self-built school-specific platforms are built online with utilizing knowledge graphs and intelligent recommendations. Thus, a blended SPOC teaching plan is designed so that the integrated and intelligent digital classroom covering both online and offline and inside and outside the classroom is carried out.

Fifth, the effective learning outcomes are yielded by means of accumulating processes and results learning outcomes. Focusing on the developmental learning outcomes of students, adhering to the student-centered, task-driven and outcome-based principles, and through an action-based teaching process, students are trained to practice the application of knowledge, effectively improve skills, and establish positive attitudes through activities such as accumulating learning notes, designing applied cases and so on. Furthermore, through a combination of formative and summative comprehensive assessments, students' learning outcomes are accumulated continuously meanwhile comprehensive vocational competencies are developed.

5 Conclusions

Our curriculum teaching reform of Three Attributes, Four Orientations, Five Dimensions is closely aligned with the practical theme that talent cultivation must meet the development requirements of new quality productive forces. It is guided by high-level, innovative and challenging standards of the first-class course and supported by a digital-intelligence platform combining universality and customization. This reform promotes to reconstruct the curriculum system, redesign teaching method, and reshape the classroom form, thereby strengthen students' comprehensive competencies and enhance the adaptability of applied talent cultivation.

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