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# *Reform and Practice of Mathematics Curriculum in Vocational University Education Based on Experiential Teaching*

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***Abstract:*** Vocational university mathematics curriculum plays a vital importance in cultivating students' logical thinking, professional competencies, and career readiness. However, existing teaching models commonly suffer from issues such as monotonous methods, insufficient practical components, and low student engagement. Guided by experiential learning principles, this study systematically reforms vocational university mathematics curriculum through content optimization, pedagogical innovation, and instructional resource development. Through task-driven activities, case studies, mathematical modeling, and simulated workplace scenarios, students actively engage in learning within real or simulated contexts, achieving a “learning by doing, doing by learning” pedagogical approach. Findings indicate that experiential teaching enhances students' comprehension and application of mathematical knowledge, practical skills, and innovative thinking, while simultaneously boosting learning initiative and professional competence. This study provides an actionable practical pathway and theoretical reference for reforming vocational university mathematics curricula.

## 1. Introduction

With the continuous improvement of China's vocational education system and ongoing adjustments to its industrial structure, vocational undergraduate education has increasingly played a pivotal role in cultivating high-caliber technical and skilled professionals. According to the Ministry of Education's Implementation Plan for Vocational Education Reform, vocational undergraduate education has become a crucial link connecting higher education with industrial development, providing significant support for students' professional competency development and career readiness enhancement. Against this backdrop, mathematics courses, as foundational subjects in vocational undergraduate education, not only cultivate students' logical thinking, computational skills, and scientific literacy but also serve as a core component in their specialized learning and professional capability formation [1-3].

Existing research and practice reveal several challenges in current vocational university mathematics curricula. First, teaching methods remain monotonous, with classrooms dominated by

teacher-centered lectures lacking effective interaction and practical components, thereby limiting students' knowledge comprehension and application capabilities. Second, students generally exhibit low learning motivation, as mathematical theories often disconnect from professional applications, resulting in weak learning initiative and knowledge transfer abilities. Third, the cultivation of practical and innovative skills is insufficient, leaving students with limited mathematical application and comprehensive problem-solving abilities when confronting real-world occupational challenges, which partially hampers the development of professional competence [4-6].

Curriculum reform grounded in experiential teaching principles offers an effective solution to these challenges. Theoretically, experiential learning emphasizes “learning by doing and doing to learn.” By engaging students in authentic scenarios and task-driven activities, it encourages active knowledge exploration and conceptual construction, thereby enriching teaching methodologies and enhancing both theoretical depth and practical value. In practice, integrating experiential activities such as case studies, mathematical modeling, and occupational role simulations into the classroom effectively bridges mathematical theory with vocational skills, enhancing students' logical thinking, comprehensive application, and innovation capabilities. Through the immersive experience of real-world tasks and scenario simulations, experiential teaching stimulates student interest, boosts learning initiative, and consequently elevates the overall teaching quality and educational outcomes of vocational university mathematics curricula.

Therefore, exploring mathematics curriculum reform for vocational undergraduate programs based on experiential teaching principles holds significant theoretical research value and practical application value. It provides actionable reform pathways and implementation references for vocational mathematics curriculum development. This research contributes to building a mathematics curriculum system that integrates theory with practice and simultaneously enhances teaching and vocational competency development, offering valuable insights for vocational education reform.

## 2. Analysis of the Current State of Mathematics Curriculum in Vocational University

Mathematics curriculum in vocational universities serves as a crucial foundation for students to master professional knowledge and cultivate logical thinking skills. Its current teaching practices directly impact students' learning outcomes and professional competency development. Through classroom observations, surveys, and faculty interviews across multiple vocational universities, it was found that students exhibit significant disparities in mathematical proficiency. Some students demonstrate limited initiative in class and lack the ability to apply mathematical theories to real-world problems. Instruction remains predominantly traditional lecture-based, with limited classroom interaction and practical components. Course content primarily focuses on foundational theories and formula derivations, lacking application cases and practical training relevant to students' professional fields and future job roles.

Regarding assessment, most courses still rely heavily on midterm and final exams. Formative and competency-based evaluations have yet to be systematically established, making it difficult to comprehensively reflect students' learning progress and skill development. Some institutions still face shortcomings in digital resource development, practical platform configuration, and faculty teaching capacity building. These limitations hinder teaching model reforms and student competency enhancement.

Based on the above findings, vocational university mathematics curriculum primarily exhibits the following issues: First, students exhibit low learning motivation and weak practical skills, coupled with insufficient awareness of independent exploration and problem-solving. This significantly constrains their ability to apply mathematical knowledge to real-world professional

challenges. Second, course content often fails to align with professional job requirements, with insufficient integration between theoretical instruction and vocational skills. Students struggle to effectively transfer classroom learning to workplace practice. Finally, evaluation methods remain overly focused on knowledge acquisition while neglecting practical skill development, depriving students of systematic learning feedback and guidance for competency enhancement.

In summary, the existing vocational university mathematics teaching model exhibits significant shortcomings in enhancing students' applied abilities and professional competence. This provides a practical rationale and direction for curriculum reform grounded in experiential teaching principles. By incorporating experiential teaching, institutions can not only diversify instructional methods and strengthen practical components but also effectively boost students' learning initiative and professional capabilities, offering a viable pathway for the innovative development of vocational university mathematics curricula.

## 3. Curriculum Reform Design for Experiential Teaching

### 3.1 Reform Objectives and Design Principles

This curriculum reform aims to effectively integrate mathematical theory with professional applications, stimulate students' interest in learning, and enhance their self-directed learning and practical skills.

Specific objectives include: (1) Strengthening students' comprehension and application of mathematical knowledge to improve their problem-solving abilities in professional contexts; (2) Cultivate students' ability to analyze real-world problems and think innovatively, promoting their comprehensive development; (3) Establish a diversified assessment system that focuses on comprehensive feedback regarding both the learning process and outcomes, providing a scientific basis for teaching improvement.

Regarding design principles, this curriculum reform adheres to the following core concepts: First, maintaining a student-centered approach that emphasizes practice and experience while strengthening students' independent inquiry capabilities; second, integrating theory with professional applications to guide students in understanding knowledge value through authentic contexts; third, diversifying teaching methods and assessment approaches to construct systematic, sustainable teaching reform plans through task-driven learning, case analysis, and collaborative learning.

### 3.2 Optimization of Teaching Content

In terms of curriculum design, this reform centers on integrating fundamental mathematical knowledge with specialized applied knowledge. On one hand, it maintains the integrity of the mathematical theoretical framework, covering foundational topics such as functions, calculus, and linear algebra to ensure students master core theories and methodologies. On the other hand, it closely aligns course content with professional job requirements and real-world case studies by incorporating mathematical modeling projects, simulated workplace scenarios, and practical data analysis tasks. This approach enhances the career relevance and applied value of mathematical knowledge.

The course structure emphasizes a progressive approach, transitioning from foundational theory to applied practice. This ensures students not only grasp core knowledge but also progressively develop their problem-analysis and problem-solving abilities. Group collaboration and task-driven learning further promote knowledge transfer and the cultivation of innovative capabilities.

### 3.3 Innovation in Teaching Methods

In terms of teaching methodology, this course reform incorporates experiential learning strategies, emphasizing “learning by doing and doing while learning.” Through task-driven approaches, case studies, role-playing, and group collaboration, it fosters active student participation and self-directed learning. In mathematical modeling courses, students complete discipline-specific data modeling tasks through teamwork, gaining hands-on experience in applying mathematical knowledge to real-world scenarios—from problem formulation and model construction to result analysis. Furthermore, off-campus practice is prioritized. Through industry-academia partnerships, virtual simulation platforms, and occupational simulation laboratories, students engage in practical activities within real or simulated environments.

### 3.4 Development of Teaching Resources

To ensure the effectiveness of the reform implementation, this course has established a multi-tiered teaching resource system. First, digital resources, including multimedia courseware, online learning platforms, and virtual simulation tools, support student self-directed learning and classroom interaction. Second, practical training bases have been developed through university-industry collaboration, establishing simulated workplace laboratories that provide authentic application scenarios and enhance hands-on experience. Third, faculty development and team building initiatives enhance instructors' experiential teaching capabilities through training, workshops, and pedagogical research activities, fostering a collaborative mechanism that integrates teaching, research, and practice. Additionally, a diversified assessment system combining process-based, competency-based, and outcome-based evaluations scientifically reflects students' learning progress and skill development, providing a foundation for subsequent instructional improvements.

## 4. Practice of Teaching Reform

### 4.1 Teaching Implementation Process

To ensure the effective implementation of experiential learning principles in vocational university mathematics curriculum, this study designed a systematic teaching implementation process encompassing three phases: pre-class preparation, in-class implementation, and post-class extension.

During the pre-class preparation phase, instructors develop detailed lesson plans based on learning objectives and student foundations. They design case-based tasks and practical projects while providing relevant learning resources and guidance plans. This enables students to preview theoretical knowledge, familiarize themselves with practical tasks, and formulate preliminary solution approaches.

During classroom implementation, experiential learning activities form the core of instruction. Integrating lectures, case studies, group discussions, and simulated practice, students actively engage in analyzing and solving mathematical problems within real or simulated contexts, embodying the “learning by doing, doing by learning” approach. Activity design emphasizes task-driven and problem-oriented methodologies, encouraging students to independently pose questions, explore solutions, and collaborate in teams to enhance logical thinking and applied skills.

During the post-class extension phase, instructors guide students to consolidate classroom knowledge and apply mathematical theories to real-world problem-solving through project assignments, online tasks, and reflective reports. A multidimensional evaluation and feedback system—including self-assessment, peer evaluation, and instructor assessment—emphasizes

process-oriented and competency-based evaluation. This helps students promptly understand their learning progress and skill development, providing scientific basis for subsequent instructional adjustments.

### 4.2 Teaching Case Showcase

In the practice of reform, this study uses mathematical modeling projects and career role-playing simulations as primary case studies, fully demonstrating the practical value of experiential learning.

Mathematical modeling projects integrate students' specialized fields to design real-world problem scenarios, such as industrial data analysis, production scheduling optimization, and financial risk assessment. Students must complete the entire process—from problem formulation and model development to computational solutions and result analysis—cultivating logical thinking, applied mathematical skills, and teamwork abilities.

Career role-playing simulations replicate professional work environments, such as engineering surveying, logistics planning, and corporate management scenarios. Students apply mathematical knowledge to solve practical problems, enhancing their professional competence and innovation capabilities. Throughout these simulations, students not only practice mathematical skills but also learn to analyze and make decisions in complex situations, strengthening their professional readiness and problem-solving abilities.

Through hands-on practice, students grasp the practical value of mathematical theories while developing comprehensive problem-solving abilities and proactive learning attitudes. This provides substantial practical support for the effectiveness of curriculum reform.

## 5. Conclusions

This study explores the design and implementation of curriculum reform for vocational university mathematics curriculum based on experiential teaching. Research indicates that through optimized course content, innovative teaching methods, and multi-tiered instructional resources, students achieve effective integration of theoretical learning and vocational skill practice. Their learning initiative, practical abilities, and innovative thinking have all significantly improved. Experiential teaching activities, such as mathematical modeling projects and simulated workplace scenarios, provide students with authentic or simulated professional contexts, facilitating the transformation of theoretical knowledge into vocational competencies. This experiential teaching-based curriculum reform not only enriches the teaching methodology system for vocational university mathematics curriculum but also offers a practical pathway to enhance students' comprehensive application abilities and professional competence. Future research could integrate digital teaching tools and industry-academia collaboration platforms to continuously optimize curriculum design and evaluation systems, thereby promoting the long-term improvement of teaching quality in vocational university mathematics education.

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## References

*[1] Ma X.J., Zhao Y.L., Lu J.C. and Wu G.(2025).Exploring Reform Pathways for Public Foundation Courses in Vocational Undergraduate Education from the Perspective of Intrinsic Motivation.Journal of HeBei Vocational University of Technology and Engineering,4,27-32.*

*[2] Lv J. Liu W.Y., Zhong T.Y., and Wang X.(2025).Practical Reform of Higher Vocational Mathematics Courses Based on Competition-Driven Teaching: The Case of the National College Students Mathematical Modeling Competition. China Educational Technology & Equipment,14,66-69.*
*[3] Li W.Z., and Du Q.X.(2025).Teaching Reform of Higher Mathematics Courses in Vocational Undergraduate Institutions Based on "Internet +".Western China Quality Education,1,25-29.*
*[4] Qiu Y.C.(2024).Research on the Role of Mathematics Courses in Empowering STEM Talent Development within Vocational Undergraduate Education. Journal of Hubei Open Vocational College,14,69-72.*
*[5] Zhang G.S.(2025).Practice and Exploration of Integrated Teaching Reform in University Mathematics Courses. University Education,14,64-67+98.*
*[6] Guo X. and Bai Q.Y.(2021).Research on the Construction of Practical Teaching Models for College Mathematics in Applied Undergraduate Institutions. Journal of Jilin Agricultural Science and Technology University,2,79-82.*