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Practical Exploration and Optimization Path of AI-empowered Personalized Mathematics Teaching in Higher Vocational Colleges

Huihong Jin*

Zhejiang Institute of Communications, Hangzhou 311112, Zhejiang, China

Author to whom correspondence should be addressed.

Abstract: Based on the Chaoxing AI Workbench, this paper targets the long-standing structural bottlenecks in higher vocational mathematics teaching, including diversified student demands, crude learning diagnosis, and insufficient teaching resources. A “Four-dimensional Linkage” enabling mechanism is constructed, which realizes precise stratification through student learning portrait diagnosis, solves the problem of homogeneous resource supply via stratified resource adaptation, runs through three classroom links with full-process teaching implementation, and guarantees personalized learning outcomes through dynamic diversified evaluation, forming a complete closed loop of “Diagnosis — Resource Supply — Teaching Implementation — Evaluation.” Practice results show that this mechanism achieves remarkable effects in improving teaching quality, narrowing gaps between students and optimizing learning experience. Aiming at practical shortcomings such as insufficient resource reserves, insufficient teachers’ digital literacy, poor technical adaptability and imperfect institutional guarantees, this paper further puts forward optimization countermeasures including inter-collegial co-construction and sharing, three-dimensional teacher transformation driving, collaborative tackling of technical defects and perfecting supporting systems, so as to provide useful reference for the intelligent transformation of public basic courses.

Keywords: Artificial intelligence; Higher vocational mathematics; Personalized teaching; Teaching students in accordance with their aptitude; Teaching reform

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1. Introduction

In recent years, documents such as the Overall Layout Plan for the Construction of Digital China and the Outline of the Plan for Building a Powerful Country through Education (2024–2035) have been issued successively, clearly requiring vigorous implementation of the national digital education strategic initiative and comprehensive promotion of education transformation empowered by artificial intelligence [1]. As a public basic course in higher vocational colleges, higher vocational mathematics plays an important role in cultivating students' scientific literacy, comprehensive ability, and sustainable development capacity [2]. However, due to the significant differences in mathematical foundations among multiple student sources, including general high school graduates, secondary vocational graduates, and single-admission students, the traditional "one-size-fits-all" teaching mode cannot help underachieving students consolidate basic knowledge [3]. How to realize genuine "teaching students in accordance with their aptitude" with the aid of artificial intelligence technology has become a practical issue facing higher vocational mathematics teaching reform. Relying on the Chaoxing AI Workbench and taking the national high-quality online course Applied Advanced Mathematics as the carrier, this paper systematically explores the internal mechanism and practical path of AI-enabled personalized higher vocational mathematics teaching, offers useful references for higher vocational mathematics to break away from the dilemma of failing to meet diversified student needs and advance the intelligent transformation of public basic courses, and helps comprehensively improve talent training quality [4].

2. Practical exploration of AI-enabled personalized higher vocational mathematics teaching

2.1. Practice overview

2.1.1. Description of research samples

In this comparative teaching practice, two parallel classes of Railway Engineering Technology majors with students from general high schools in the Grade 2025 are selected as research samples, with 40 students in each class. The control class adopts conventional traditional teaching throughout the whole semester, while the experimental class introduces AI tools to build personalized learning paths. Before the formal practice, a mathematics placement test and learning demand questionnaire are distributed to all students. After comprehensive comparison of the mathematical foundation, autonomous learning ability, and curriculum learning demands of the two groups, there is no statistically significant difference in all indicators, which meets the basic conditions for comparative research. Applied Advanced Mathematics is selected as the experimental course for the first semester of the 2025–2026 academic year, with a total of 16 weeks and 64 class hours.

2.1.2. Platform and tools

The whole teaching practice takes the Chaoxing Xuexitong intelligent teaching platform as the online carrier, and two generative AI tools, Doubao and iFLYTEK Spark, are used to assist daily teaching.

2.2. Teaching implementation process

2.2.1. Preparatory work

All preparatory work is completed one week before the course starts. First, learning assessment tests and online questionnaires are organized for students in the experimental class. The AI system automatically analyzes collected learning data and generates exclusive learning files for each student, based on which students are divided into initial learning levels. Mathematics teachers cooperate with railway engineering professional teachers to build a stratified course resource library covering core chapters including limits, derivatives, integrals, and probability and statistics, uploading basic-level micro-lessons and courseware, intermediate variant exercises, and extended professional application cases. Matching classroom objectives, in-class exercises, and assessment standards are set separately for students with three different types of learning weaknesses [5–7].

2.2.2. Teaching implementation stage (Week 1 to Week 15)

Pre-class, in-class, and post-class stratified learning arrangements with different focuses are arranged for each class.

Pre-class: The online platform pushes preview micro-lessons, knowledge summary lists, and pre-class self-test exercises with matching difficulty according to students' previously divided learning levels. For example, students at the basic level focus on mastering fundamental concepts and proficient basic calculations, while students at the extended level need to sort out application ideas of knowledge points in professional scenarios combined with railway engineering cases in advance.

In-class: Teachers uniformly explain core chapter knowledge and sort out common problems arising from preview in the first half of class. In the second half, stratified targeted exercises are arranged with different tasks for different levels: the basic group consolidates basic question types, the intermediate group completes variant questions and simple applications, and the extended group solves comprehensive application questions integrated with railway engineering professional backgrounds [8]. Five minutes are reserved before class dismissal for free Q&A. Fragmented questions are answered instantly by AI teaching assistants, while teachers focus on responding to common difficult problems and organizing learning groups of different levels to exchange and comment on assignments.

Post-class: The platform adaptively assigns stratified homework and review materials according to students' learning status. Objective exercises are automatically graded by the system, while subjective questions are graded by teachers according to student levels. AI tools integrate all error data of students to generate exclusive error notebooks, and push explanation micro-lessons and similar variant exercises targeting weak knowledge points. The platform generates a learning analysis report every week: personalized learning optimization suggestions are pushed to all students, and overall weak modules and abnormal individual status of the class are fed back to teachers for dynamic adjustment of teaching strategies.

2.2.3. Assessment stage

The 16th week is set as the final review and assessment stage. Two completely different comprehensive assessment schemes are adopted for the two groups. The experimental class adopts a three-dimensional differentiated evaluation system: process evaluation accounts for 40%, differentiated final examination accounts for 40%, and value-added evaluation accounts for 20%. The control class follows the traditional evaluation system: usual performance accounts for 50% and the final examination accounts for 50%. After all final assessments, satisfaction questionnaires are distributed to all participating students to collect genuine subjective feedback as reference for subsequent optimization of the AI personalized teaching model.

2.3. Analysis of practical results

2.3.1. Comparison of assessment scores

Comparison of final scores directly reflects the differences between the two teaching modes. The average score of the control class is 72.36 with a pass rate of 81.55%, and excellent students account for 18.37%; the average score of the experimental class reaches 81.52 with a pass rate of 95.88%, and the proportion of excellent students rises to 36.73%. It is obvious that students at the basic level in the experimental class achieve much higher score improvement than students with equivalent foundation in the control class, and the polarization of grades in the class is significantly alleviated.

2.3.2. Student satisfaction analysis

40 satisfaction questionnaires are distributed to the experimental class, and all 40 valid questionnaires are recovered. The results show that 91.8% of students recognize the stratified resource pushing mode and think the resource difficulty matches their cognitive level; 87.7% of students hold the view that the personalized error review function helps them quickly make up knowledge deficiencies; 85.2% are satisfied with the differentiated assessment and believe value-added evaluation can fairly reflect their learning outcomes; only 8.1% feel unadapted to the operation process. The satisfaction rate of all dimensions remains above 85%, which proves high acceptance and recognition of this teaching model among students.

2.3.3. Existing problems

Combined with teaching practice, four prominent problems exist in the current model: first, the reserve of high-quality stratified resources is insufficient, and high-level project-based teaching resources matching Railway Engineering Technology major are scarce; second, teachers' digital literacy needs to be improved, and some middle-aged and elderly teachers cannot skillfully use functions such as learning portraits and data review to carry in-depth personalized teaching design; third, technical adaptability has shortcomings — the AI cannot grade subjective advanced mathematics questions, and the intelligent Q&A system has insufficient accuracy in analyzing complex calculation and proof questions of advanced mathematics with occasional biased answers; fourth, supporting institutions are imperfect, and there is no matching performance appraisal system to support the regular promotion of personalized teaching [9–11].

3. Optimization strategies for AI-enabled personalized higher vocational mathematics teaching

3.1. Co-construction and sharing of stratified resources to solve insufficient resource reserves

Establish an inter-collegial collaborative resource co-construction mechanism. Restricted by the limited resource development capacity of a single college, it is proposed that the Provincial Vocational Mathematics Society takes the lead to unite multiple higher vocational colleges in the region to form a "Higher Vocational Mathematics Stratified Resource Co-construction Alliance." In accordance with the principle of unified standards, division of labor, and achievement sharing, stratified resource packages covering basic remediation, college-upgrading examination, and professional application are jointly developed [12]. Each college undertakes the construction of corresponding modules based on its advantageous majors, and all alliance colleges share the completed resources to improve overall resource quality.

Dynamically update resources with generative artificial intelligence. Make full use of the content generation capacity of generative AI to assist teachers in quickly drafting stratified exercises, variant training and cases, with teachers responsible for review and improvement to greatly boost development efficiency. Establish a resource usage monitoring mechanism to mark and warn resources with low usage and poor feedback, and push such resources to the management terminal for developers to optimize, realizing dynamic iterative updating.

3.2. Three-dimensional drive for teachers' transformation to address insufficient digital literacy

Build a progressive digital literacy training system. Primary training focuses on basic platform operations to ensure teachers skillfully complete routine tasks such as preview release, classroom interaction, and homework grading; intermediate training centers on interpretation of learning portraits, data review, and design of stratified resource pushing strategies; advanced training covers AI-assisted teaching design, personalized learning path planning, and improvement of teaching research capabilities [13].

Build an integrated teacher practice community for research, training, and application. Relying on the Chaoxing AI Workbench, build an in-school digital teaching practice community for mathematics teachers. Invite professional teachers, off-campus experts, and enterprise technical staff to provide regular guidance, and hold regular seminars on personalized teaching case sharing, classroom observation, and lesson evaluation. Encourage teachers to publish stratified teaching designs and experience of AI tool application as well as learning analysis reports in the community, and solve practical difficulties through peer review and group discussion to form a benign ecosystem of learning through research, practicing through learning, and researching through practice.

Set up special incentives for AI teaching innovation. Incorporate teachers' capacity for AI-enabled personalized teaching design into the teaching ability evaluation system, and set special honors such as "AI Teaching Innovation Award" and "Excellent Personalized Teaching Case Award." Commend teachers with remarkable reform and provide resource preference to stimulate their internal motivation for active learning and innovation.

3.3. Collaborative tackling of technical deficiencies to improve technical adaptability

Optimize the adaptability of AI Q&A and grading in the mathematics field. Higher vocational colleges shall cooperate with platform technical service providers to carry out technical iteration targeting pain points of higher vocational mathematics. Open typical question banks, common error sets, and standard analysis templates of calculation and proof questions to technical teams for targeted fine-tuning of large mathematical models, so as to improve recognition accuracy of complex calculation steps and proof logic chains. Prioritize tools supporting mathematical dedicated functions, including formula recognition, step derivation, and graph drawing, to avoid maladaptation of general AI in mathematics teaching.

Continuously optimize AI models based on student learning data. Regularly classify and analyze wrong cases of AI Q&A, and feed back data of frequently incorrect and biased answers to technical teams for targeted optimization of model algorithms. Collect student satisfaction evaluations on AI Q&A, categorize feedback into three levels: fully helpful, partially referential, and ineffective, and gradually polish Q&A functions to make intelligent tools better fit the real scenarios of daily higher vocational mathematics teaching [14].

3.4. Improve supporting institutions to guarantee regular implementation

Establish supporting management systems matching personalized teaching. First, optimize class hour allocation according to teaching demands, appropriately increase higher vocational mathematics class hours and reserve time for stratified teaching, AI operation and one-on-one tutoring; second, reform performance appraisal and incorporate digital personalized teaching design, resource development and teaching effects into teachers' performance indicators to stimulate teaching reform enthusiasm; third, set up a long-term supervision mechanism, with the Academic Affairs Office conducting regular inspections and collecting feedback to dynamically optimize implementation plans [15].

Build a long-term operation mechanism for a stable teaching mode. Mathematics teaching and research offices of all colleges may take AI-assisted stratified teaching as core annual teaching research tasks. Directors of teaching and research offices coordinate overall work, while course leaders and backbone teachers take the lead in demonstration classes followed by young teachers. Implementation plans and schedules are formulated at the beginning of each semester; special teaching research meetings are held every 2–3 weeks during the semester; teaching effects are assessed and experience summarized at the end of each semester. Regular communication mechanisms with the Academic Affairs Office and Information Center as well as secondary colleges are established to ensure smooth resource docking and technical support.

4. Conclusion and reflections

Based on the practical difficulties of realizing "teaching students in accordance with their aptitude" in higher vocational mathematics, this paper constructs a four-dimensional linkage AI-enabled personalized learning mechanism. Verified by teaching practice, this mechanism achieves remarkable results in improving teaching quality, narrowing student gaps, and optimizing learning experience. Teaching reform cannot be accomplished overnight. At present, insufficient resource reserves, inadequate teachers' digital literacy, poor technical adaptability, and imperfect institutional guarantees still restrict the full release of AI teaching efficiency. In the future, on the basis of optimizing the personalized teaching system, key measures including inter-collegial co-construction and sharing of high-quality resources, three-dimensional drive for teachers' digital transformation, collaborative tackling of technical defects and complete supporting institutions shall be solidly promoted to fully unleash the precise empowering advantages of artificial intelligence, realize differentiated adaptation and integration with vocational posts, carry out student-centered personalized teaching, support student development and provide solid support for cultivating high-quality technical and skilled talents.

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Disclosure statement

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References

[1] Yang Y, Tang W, 2025, Research on Practical Path of "Promoting Learning through Competition" Teaching Mode

of Mathematical Modeling in Higher Vocational Colleges. Education Watch, 14(25): 66–70.

[2] Zhang L, Jia HX, Shan DM, 2025, Thoughts on In-depth Integration of Advanced Mathematics Teaching and Artificial Intelligence. China Journal of Multimedia & Network Teaching (Mid-month), 2025(10): 25–28.

[3] Zheng Y, Wang YD, 2025, Practical Research on Generative AI-enabled Interdisciplinary Project-based Learning — A Case Study of “Liuzhou Traditional Culture” Project. Guangxi Education, 2025(32): 56–59.

[4] Li HX, Wang Y, 2025, Research on Digital Intelligence-enabled Innovative Education Mode of Advanced Mathematics in Higher Vocational Colleges. Microcomputer, 2025(11): 76–78.

[5] Dong YH, 2025, Design of Higher Vocational Mathematics Teaching Auxiliary System Based on Artificial Intelligence Technology. Software, 46(8): 74–76.

[6] Liu SH, 2025, Exploration on Digital Teaching Reform of Higher Vocational Mathematics Courses Assisted by AI. Knowledge Window (Teacher Edition), 2025(12): 114–116.

[7] Wang Q, Wang ZG, 2025, Research and Practice of Precise Teaching Mode of Higher Vocational Mathematics Based on Large AI Model. Transportation Technology and Management, 6(18): 186–188.

[8] Yan X, 2026, Research and Practice on Standardized Teaching Reform of Higher Vocational Advanced Mathematics Enabled by AI — Taking the Concept of Definite Integral as an Example. Standard Life, 2026(2): 96–98.

[9] Mei F, 2025, Reform and Practice of “Intelligent Interaction — Diversified Evaluation” Teaching Mode of Higher Vocational Advanced Mathematics Based on AI + Xuexitong. Journal of Science and Education (Electronic Edition), 2026(11): 233–235.

[10] Li XY, 2025, Research on Innovation and Practical Path of AI-enabled Higher Vocational Mathematics Teaching Mode. China New Telecommunications, 27(18): 155–157.

[11] Ding Y, 2025, Preliminary Exploration on Transformation Strategies of Higher Vocational Mathematics Teaching Enabled by AI. Wenyuan (Senior High School Edition), 2025(6): 639–641.

[12] Sa BH, Ying XY, Shu DY, et al., 2026, Reconstruction of Blended Teaching Mode of Advanced Mathematics for College-upgrading Exams Enabled by AI from the Perspective of Integrated Teaching, Learning and Evaluation. Digital User, 2026(3): 175–177.

[13] Chen W, 2026, Internal Mechanism and Practical Approach of AI-enabled Higher Vocational Teaching Reform. Online Learning, 2026(1): 61–63.

[14] Kang CP, 2026, Discussion on Implementation Strategies of Artificial Intelligence Technology in Higher Vocational Mathematics Teaching. Modern Vocational Education, 2026(11): 161–164.

[15] Shi Y, 2026, Research on Mathematics Teaching Methods in Higher Vocational Colleges under the Background of Artificial Intelligence. China Electronic Commerce, 32(1): 1–3.