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Reform Strategies of Advanced Mathematics Courses for Vocational Undergraduate Education in the AI Era

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Abstract: The deep integration of artificial intelligence (AI) technology and the real economy is driving industries to accelerate transformation toward high-end, intelligent, and digital development. However, Advanced Mathematics, as a core public basic course for vocational undergraduate education, still faces problems such as outdated curriculum concepts, disconnection between content and professional posts, single teaching mode, and insufficient integrated teaching competence of teachers. These issues make it difficult to align with the positioning of vocational undergraduate education and meet the demand for high-quality technical and skilled talents in the new era. Based on the educational essence and talent training objectives of vocational undergraduate education, combined with the core advantages of AI in empowering education and teaching, this paper systematically elaborates an integrated reform path from six dimensions: curriculum concept innovation, content system reconstruction, teaching mode innovation, evaluation mechanism reform, teaching staff construction, and teaching resource support. It promotes the transformation and upgrading of Advanced Mathematics courses toward literacy empowerment, application orientation, digital-intelligent integration, and post-course docking. This will effectively enhance the supporting role of mathematics courses in professional learning and the empowering value for vocational ability, and lay a solid foundation for the high-quality development of vocational undergraduate education.

Keywords: Artificial intelligence; Vocational undergraduate; Advanced mathematics; Curriculum reform; Digital-intelligent integration

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1. Introduction

Vocational undergraduate education is an important part of the modern vocational education system. It undertakes the mission of cultivating applied talents who adapt to industrial transformation and upgrading, possess high-level technical skills, and can solve practical problems in complex posts. It is also a key carrier for opening up the promotion channel for vocational education students and improving the training level of

technical and skilled talents. At the same time, AI technology provides new technical support for education and teaching reform [1]. Technical means such as accurate learning situation analysis, personalized teaching push, intelligent Q&A tutoring, and virtual simulation teaching offer feasible paths to break through the dilemmas of traditional mathematics teaching and realize teaching according to students' aptitudes [2].

From the current situation of Advanced Mathematics teaching in vocational undergraduate education, most colleges still adopt the traditional discipline-oriented teaching mode. Curriculum construction is seriously disconnected from the development of the times, industrial needs, and professional learning situations. The curriculum positioning fails to highlight the characteristics of vocational education, the content setting is divorced from actual post needs, the teaching process lacks the deep empowerment of digital-intelligent technology, and the evaluation methods can hardly comprehensively measure students' ability and literacy. The teaching staff also cannot adapt to the integrated teaching demand of "Mathematics + Major + AI Technology" [3]. As a result, students have low interest in mathematics learning, low efficiency of knowledge internalization, and weak application ability, lacking solid mathematical foundation support for subsequent professional learning and post-practice.

2. Core basis for the reform of advanced mathematics courses for vocational undergraduate education in the AI era

The reform of Advanced Mathematics courses for vocational undergraduate education is not carried out blindly, but based on three core bases: policy orientation, industrial demand, and learning situation characteristics, to ensure accurate reform direction, feasible paths, practicality, and effective results [4].

From the perspective of policy orientation, the state has successively issued a number of policy documents to promote the high-quality development of vocational education in recent years. It clearly requires vocational undergraduate education to strengthen its characteristics, deepen curriculum and teaching material reform, promote the deep integration of information technology and education and teaching, optimize the public basic course teaching system, and highlight the vocational and applied nature of curriculum teaching [5]. The new version of the *Mathematics Teaching Standard for Vocational Colleges* further emphasizes that mathematics teaching should break disciplinary barriers [7], focus on the integration of posts, courses, competitions and certificates, and customize teaching content to meet the talent training needs of different professional groups. These policies point out the direction for the reform of Advanced Mathematics courses and define the core criteria for reform [6].

From the perspective of industrial demand, the intelligent transformation of industries driven by AI has made the demand for mathematical ability in various industrial posts increasingly refined and comprehensive. The intelligent manufacturing field requires talents to complete equipment parameter optimization, engineering system modeling, and operation error analysis based on mathematical knowledge. The information technology field needs talents to master core mathematical abilities such as matrix operation, algorithm logic analysis, and data visualization. Majors such as finance, trade, and modern services focus on mathematical application abilities such as statistical analysis, risk quantification, and data decision-making [8]. The traditional mathematics teaching mode, which is purely theoretical and calculation-oriented, can no longer meet the actual needs of posts. The curriculum content and teaching mode must be optimized and adjusted to fit the ability standards of industrial posts.

From the perspective of learning situation characteristics, vocational undergraduate students have a

diverse student source and uneven mathematical foundation. Students generally have low interest in learning abstract theoretical knowledge, but have strong practical ability and higher acceptance of practical content closely related to majors and posts. The traditional one-size-fits-all teaching mode cannot take into account the learning needs of students at different levels. Implementing layered teaching and practical teaching with the help of AI technology has become an inevitable choice to fit the learning situation and improve teaching quality [9].

3. Main problems existing in current advanced mathematics courses for vocational undergraduate education

At present, there are still many deep-seated problems in the teaching of Advanced Mathematics courses for vocational undergraduate education, which restrict the improvement of teaching quality and the development of educational function in an all-round way.

At the curriculum concept level, most colleges still uphold the discipline-oriented teaching concept, taking the integrity of theoretical knowledge and logical rigor as the core of curriculum construction. They ignore the core positioning of the vocational, applied, and high-level nature of vocational undergraduate education, fail to clarify the internal connection between Advanced Mathematics and professional courses and post abilities, and simply teach mathematics as an independent theoretical discipline [10]. The curriculum objectives overemphasize the teaching of theoretical knowledge and the cultivation of calculation ability, ignoring the cultivation of students' mathematical application ability and core literacy, which is seriously disconnected from the literacy-oriented and application-oriented teaching requirements in the AI era.

At the curriculum content system level, the existing teaching content structure is solidified and outdated, generally following the undergraduate mathematics textbook system, with the core framework of definitions, theorems, theoretical deductions, and exercises. Cumbersome theoretical proofs and complex numerical calculations account for an excessively high proportion. The content selection emphasizes theory over application, and adopts a unified content setting mode without differentiated and modular design for different professional groups. The content has very low fit with professional core abilities and actual post needs. At the same time, it lacks the integration of relevant mathematical knowledge in the AI era, fails to reflect the application value of mathematics in cutting-edge technologies, and is seriously short of practical teaching content. It is difficult for students to establish a connection between mathematical knowledge and professional problems and practical applications, and they have long been trapped in the dilemma of understanding theories but being unable to apply them in practice [11].

At the teaching mode level, the traditional classroom lecturing teaching is still the main method. The indoctrination teaching mode dominated by teachers and passively accepted by students is mainstream. The classroom lacks interactive inquiry, practical operation, and collaborative learning, making it difficult to stimulate students' learning initiative and creativity. Even if some colleges introduce digital teaching tools, they only stay at the shallow application stage, such as courseware playing and online answering. Technologies such as AI and big data have not been deeply integrated into the whole teaching process before, during, and after class. Layered and precise teaching is difficult to implement, and personalized teaching cannot be carried out according to students' basic differences [12].

At the teaching evaluation level, the single summative evaluation mode is still adopted, taking the final closed-book written examination results as the core assessment basis. The assessment content focuses on the

memorization of theoretical knowledge and mechanical calculation, ignoring the assessment of students' core abilities such as mathematical modeling, problem-solving, and practical application. The whole evaluation focuses on results rather than process, lacking careful consideration of students' pre-class preview, classroom participation, homework completion, practical training, and other process-based performances. The evaluation subject is mainly one-way teacher evaluation, lacking student self-evaluation, peer evaluation, and enterprise tutor evaluation. The evaluation results cannot comprehensively and objectively reflect students' learning effects and ability literacy [13].

At the level of teaching staff construction and resource support, some mathematics teachers have been engaged in traditional theoretical teaching for a long time with solidified teaching thinking. They have an incomplete understanding of the talent training positioning of vocational undergraduate education, insufficient digital teaching literacy, and lack comprehensive abilities such as AI teaching tool application, mathematical software operation, cross-professional project design, and professional case development. They are incompetent in mathematics teaching under the background of digital-intelligent integration. At the same time, there is a shortage of high-quality digital-intelligent mathematics teaching resources suitable for vocational undergraduate education, a lack of loose-leaf and practical textbooks, and imperfect functions of intelligent teaching platforms. The core functions such as learning situation analysis, resource push, and process evaluation are not sound, which cannot provide sufficient resources and platform support for intelligent teaching.

4. Core strategies for the reform of advanced mathematics courses for vocational undergraduate education in the AI era

To promote the reform of Advanced Mathematics courses for vocational undergraduate education in the AI era, it is necessary to base it on problem-oriented principles, implement systematic optimization around the whole process and various elements of the curriculum, and build a curriculum teaching system with advanced concepts, practical content, efficient teaching, scientific evaluation, and strong support [14].

The primary task is to innovate the teaching concept, completely break the solidified thinking of traditional discipline orientation, establish the curriculum positioning of literacy as the core, application orientation, digital-intelligent integration, and post-course docking. It always closely follows the characteristics of vocational undergraduate education and clarifies the core functions of Advanced Mathematics: consolidating the foundation, supporting majors, empowering occupations, and cultivating innovation.

In terms of curriculum content reconstruction, completely break the traditional disciplinary content framework. Combined with the needs of professional groups and the ability requirements of the AI era, build a four-in-one content system including compulsory basic courses, professional adaptation, innovation expansion, and technology integration. Retain core basic contents such as functions, limits, calculus, and probability and statistics, dilute cumbersome theoretical deductions and complex mechanical calculations, and focus on the explanation of the essence of mathematical concepts and ideological methods. Customize differentiated professional adaptation content around different professional groups such as intelligent manufacturing, information technology, finance and trade, and integrate real professional cases and actual post problems into corresponding knowledge points. At the same time, add innovative expansion content such as mathematical modeling, data processing, and AI mathematics foundation, and integrate the teaching of mathematical software operations such as MATLAB and Python throughout the process. Complex calculations are toolized

to free students from mechanical calculations and focus on problem analysis and model construction. At the same time, develop school-based digital textbooks in loose-leaf and workbook styles synchronously, dynamically update industrial cases and teaching content, and strengthen the practicality and cutting-edge of the content.

In terms of teaching mode innovation, rely on AI technology to build a whole-process intelligent teaching mode and reconstruct the teaching closed-loop before, during, and after class. Before class, complete learning situation data analysis with the help of AI teaching assistants, push differentiated preview resources, and accurately locate key and difficult teaching points. During class, adopt the teaching method combining problem guidance, interactive inquiry, and practical operation. Master students' learning status in real time with the help of classroom monitoring systems, and dynamically adjust the teaching rhythm. Use virtual simulation, knowledge graphs, and other technologies to solve the problem of understanding abstract knowledge points. Implement layered teaching according to students' basic differences and match learning tasks and practice contents of different difficulties. After class, rely on the AI teaching platform to complete personalized review push, intelligent Q&A and homework correction. Teachers carry out precise tutoring for underachieving students. Synchronously implement project-driven teaching, integrate knowledge points into real professional projects, build a three-level practice system of basic projects, comprehensive projects, and innovative projects, and promote students to learn in practice, application and creation. At the same time, link the three major classrooms of classroom teaching, on-campus training, and enterprise practice, and deepen the integration of industry and education with the help of mathematics clubs, skills competitions, school-enterprise practices and other activities to improve students' practical application ability.

To ensure the effective implementation of the reform, it is also necessary to build a compound mathematics teaching staff. Through special training, enterprise practice, teaching and research linkage and other ways, improve teachers' digital teaching literacy, interdisciplinary integrated teaching ability and practical teaching ability. Regularly carry out special training on AI teaching technology, professional group knowledge, curriculum design, etc. Promote mathematics teachers to go deep into the front line of enterprises to understand post-mathematics needs and accumulate practical teaching cases. Set up cross-professional teaching and research teams to jointly promote curriculum construction together with professional teachers and enterprise experts. Synchronously improve digital-intelligent teaching resources and platform support, build an intelligent teaching platform integrating learning situation analysis, resource push, teaching implementation, and evaluation assessment. Develop high-quality resources such as professional case libraries, digital micro-lectures, virtual simulation teaching resources, and intelligent question banks. Promote the co-construction and sharing of inter-school and school-enterprise resources to provide all-round support for curriculum reform.

5. Conclusion

The advent of the AI era has not only opened up new opportunities for the transformation and upgrading of Advanced Mathematics courses for vocational undergraduate education, but also put forward higher requirements for its teaching. The reform of Advanced Mathematics courses is a long-term and systematic project, which cannot rely on the optimization of a single link. It must take concept innovation as the guide, content reconstruction as the core, mode innovation as the path, evaluation reform as the orientation, and teachers and resources as the support. We should comprehensively promote the deep integration of the curriculum with AI technology, professional education and industrial needs, and fundamentally change

the situation of "emphasizing theory over practice and knowledge over ability" in traditional mathematics teaching. Promote the fundamental transformation of the curriculum from knowledge instillation to literacy empowerment, from theory-led to application practice, and from traditional closed to digital-intelligent open. Make Advanced Mathematics effectively play the educational function of supporting professional learning, empowering vocational development, and cultivating core literacy.

In the follow-up teaching practice, vocational undergraduate colleges should continuously track the development trend of AI and the changes in industrial post needs. Combined with the learning situation and teaching feedback, dynamically optimize the curriculum content, teaching mode and support system. Steadily improve the teaching quality of Advanced Mathematics, strive to cultivate high-quality technical and skilled talents meeting the needs of the AI era, help the high-quality development of modern vocational education, and better serve the national industrial intelligent and digital transformation strategy.

Disclosure statement

The author declares no conflict of interest.

References

[1] Ministry of Education of the People's Republic of China, 2021, Opinions on Promoting the High-Quality Development of Modern Vocational Education, Beijing.

[2] Mathematics Teaching Standard for Vocational Colleges (2024 Edition), 2024. Higher Education Press, Beijing.

[3] Zhang L, 2025, Preliminary Exploration on the Reform of Higher Vocational Mathematics Courses Driven by Artificial Intelligence and Mathematical Modeling. Vocational Education Research, 10: 45–49.

[4] Wang H, 2025, Practical Research on AI-Empowered Intelligent Teaching of Higher Vocational Mathematics. Guizhou Education Daily, December 26, 2025.

[5] Chen C, 2025, Generative AI-Empowered Higher Vocational Teaching Reform. Chinese Vocational and Technical Education, 6: 78–82.

[6] Li J, 2025, Consolidating the Mathematical Foundation and Empowering Vocational Development – Practice of Mathematics Curriculum Reform in Vocational Undergraduate Education. China Education News Network, July 15, 2025.

[7] Zhao Y, 2025, Innovative Practice of "Unity of Knowledge and Action · Digital-Intelligent Empowerment" Teaching Reform of Advanced Mathematics. Vocational and Technical Education, 11: 34–38.

[8] Wu L, 2025, AI-Empowered Dual-Track Innovation and Future Prospect of Mathematics Education in China. Educational Information Technology, 6: 23–26.

[9] Zhou M, 2026, Teaching Reform and Practice of Advanced Mathematics with "One Core, One Drive and Three-Dimensional Integration". Vocational Education, 1: 112–118.

[10] Fan H, 2025, Discussion on the Teaching Reform of Advanced Mathematics in Applied Undergraduate Universities. Creative Education Studies, 13(11): 95–101.

[11] Li S, Yang T, 2026, Research and Exploration on AI-Empowered Blended Teaching Reform of Advanced Mathematics. Advances in Education, 16(1): 915–923.

[12] Shi W, Ma S, 2026, Research on the Path of Mathematics-Empowered New Engineering Construction Driven by Artificial Intelligence. China Construction Education, 2: 78–83.

[13] Lu Y, 2025, Reform and Practice of Integrating "AI + Ideological and Political Education + Projects" into Blended Teaching – Taking Advanced Mathematics as an Example. Educational Technology, 2025, 12: 106–110.

[14] Xing R, Xu H, 2025, Teaching Exploration of Advanced Mathematics for AI Majors Oriented to Engineering Education Accreditation System. Advances in Education, 15(5): 1545–1549.