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Integrating Information Technology and Artificial Intelligence in Higher Mathematics Education for Vocational College

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ABSTRACT
This paper explores innovative strategies for integrating information technology (IT) and artificial intelligence (AI) tools, specifically the DeepSeek platform, into higher mathematics education for vocational college students. With a focus on students who often face challenges due to weaker foundational mathematical skills, the study highlights how AI-driven solutions can enhance teaching efficiency, improve interactive learning, and personalize educational experiences. By analyzing real-world implementations in universities and vocational institutions, this paper provides actionable insights for educators aiming to bridge the gap between theoretical knowledge and practical application through AI.

KEYWORDS
DeepSeek; AI; vocational mathematics education; advanced mathematics; Challenges

1 Introduction

This paper argues that the necessity of integrating AI tools like DeepSeek into vocational mathematics education.The rapid advancement of artificial intelligence (AI) has influenced a lot across educational landscapes. At the same time, it has also brought transformative opportunities, especially for traditional disciplines like advanced mathematics, which are often regarded as challenging subjects.

Students in higher vocational colleges come from different sources, such as those who took the college entrance examination, those admitted through the early admission batch, and those from the 3+2 program. They have diverse educational backgrounds and relatively weak mathematical foundations. Thus, the integration of AI-driven tools and informatized teaching methods has become not just an innovation but a necessity. These students, who are training for technically demanding careers in fields like engineering, logistics, and applied sciences, require a teaching method that bridges abstract mathematical theories with practical vocational skills[1].However, conventional teaching models, which prioritize standardized lectures and passive learning, frequently fail to address their unique needs. So it leads to disengagement, knowledge gaps.

In recent years, the challenges faced by vocational mathematics education have intensified. Students struggle with foundational concepts in calculus, which are critical for understanding advanced technical subjects. For instance, topics like derivatives are rarely taught within vocational scenarios, such as optimizing mechanical systems or analyzing supply chain data. Additionally, large class sizes and limited instructional resources hindered the development of personalized tutoring, leaving many students unable to keep up with the course progress.

The integration of informatized teaching methods, particularly AI-powered platforms like DeepSeek, offers a promising solution to these systemic challenges. Unlike the common e-learning tools, DeepSeek—a large language model (LLM) with advanced reasoning, search augmentation, and adaptive learning capabilities—is uniquely suited to address the needs of vocational students. DeepSeek is able to decompose complex problems into step-by-step explanations, generate dynamic visualizations, and provide real-time feedback aligns with the practical, hands-on learning ethos of vocational education.

For example, at Zhejiang University, the adoption of DeepSeek in calculus courses led to a 22% improvement in exam scores by enabling students to visualize abstract concepts like integration through AI-generated simulations. Similarly, Renmin University reported that AI teaching assistants powered by DeepSeek handled over 2,000 daily queries, freeing instructors to focus on mentorship and interactive problem-solving[3]. This paper examines how DeepSeek and similar technologies can revolutionize pedagogy, improve teacher-student interactions, and address the unique needs of vocational learners.

2 Challenges in Vocational Mathematics Education

In higher vocational colleges, the advanced mathematics courses are confronted with several challenges,today we just state from the aspects of teachers and students:

2.1 From the Teachers' Aspect

2.1.1 Teaching methods

Many teachers still rely on traditional teaching models, such as standardized lectures and passive learning approaches. These methods often fail to adapt to the diverse learning needs of students in vocational colleges. For example, they may not effectively bridge the gap between abstract mathematical theories and practical vocational skills, making it difficult for students to understand and apply the knowledge[4].

2.1.2 Lack of personalized instruction

Due to large class sizes, teachers have limited time and energy to provide personalized guidance to each student. They are unable to fully address the individual learning difficulties and progress of students, which may lead to some students falling behind and losing interest in the subject.

2.1.3 Inadequate integration of AI and informatization

Teachers may lack the necessary skills and knowledge to effectively integrate AI-driven tools and informatized teaching methods into their courses. This restricts the potential benefits that these modern technologies can bring to mathematics teaching, such as more interactive and engaging learning experiences[5].

2.2 Based on experience and research, it has been shown that vocational students face four systemic barriers

2.2.1 Diverse educational backgrounds

Students in higher vocational colleges come from various sources, such as different high school education systems or vocational training programs. They have different levels of mathematical foundations, which makes it challenging to design a unified teaching plan that meets the needs of all students.

2.2.2 Weak mathematical foundation

Generally, students in vocational colleges have relatively weak mathematical foundations. They may struggle with basic concepts in calculus, linear algebra, and statistics, which are essential for understanding advanced mathematical content. This weak foundation can lead to difficulties in keeping up with the course progress and a lack of confidence in learning mathematics.

2.2.3 Lack of interest and motivation

The abstract nature of advanced mathematics often makes it difficult for students to see its practical applications in their future careers. For instance, only 23% of students in a 2024 survey at Henan Industrial Vocational College linked calculus to real-world engineering tasks As a result, they may lack interest and motivation in learning the subject, which can lead to disengagement, knowledge gaps, and even high dropout rates. Additionally, the pressure of other vocational courses may also cause students to allocate less time and energy to mathematics learning.

2.2.4 Inefficient Assessment

The feedback and evaluation in traditional mathematics classrooms cannot be timely provided to individuals, and cannot quickly grasp the knowledge blind spots of each student, perpetuating knowledge gaps.

These challenges demand solutions that combine adaptive teaching methodologies with scalable technological interventions.

3 The necessity of integrating AI into higher mathematics courses, taking deepseek as an example

3.1 Knowledge visualization: making abstraction easier to understand

Calculus theory has always been known for its abstract and difficult to understand nature. The concepts of limits, derivatives, integrals, etc. often only exist in abstract mathematical symbols and complex formula derivations, making it difficult for students to construct clear images in their minds to understand their essence. Traditional teaching relies on

blackboard writing and simple two-dimensional graphics, which makes it difficult to fully display the connotation of knowledge[7]. The integration of AI has brought about a turning point. Taking DeepSeek as an example, it is capable of visualizing abstract concepts in calculus through its powerful graphics processing and simulation capabilities. For example, when explaining the concept of limits, using animation to simulate the dynamic changes in function values as the independent variable approaches a certain value, students can intuitively see how the function graph approaches a specific value infinitely, which is much easier to understand than simply relying on formulas. For partial derivatives of multivariate functions, 3D modeling is used to demonstrate the rate of change of the function in different directions, allowing students to understand the geometric meaning of partial derivatives from the perspective of three-dimensional space. This visual presentation method transforms originally dull and abstract knowledge into vivid and intuitive visual experiences, greatly reducing the difficulty of students' understanding of knowledge and stimulating their interest in learning advanced mathematics, making them more actively engaged in learning.

3.2 Revolutionizing Teacher-Student Interaction: creating a vibrant classroom

In traditional higher mathematics classrooms, the form of teacher-student interaction is relatively simple, mostly consisting of teacher questions and student answers, and due to limited classroom time, the range of students participating in the interaction is relatively narrow. The addition of AI has broken this deadlock. With the help of AI intelligent teaching platforms, teachers can carry out diverse interactive activities[8]. For example, using online discussion forums, teachers can publish practical application problems related to calculus courses in advance, such as using derivative analysis to analyze economic growth models. Students can express their opinions through the platform at any time after class, and teachers can also participate in real-time discussions to guide students to think deeply. In the classroom, teachers can also use AI tools to conduct real-time quizzes. After students answer questions through mobile devices, the AI system quickly corrects and provides feedback on the results. Based on the feedback, teachers can provide real-time explanations and interactive Q&A for common problems among students. In addition, AI virtual teaching assistants can answer students' questions at any time and provide 24-hour uninterrupted learning support, which makes teacher-student interaction no longer limited by classroom time and space, greatly enriching the forms and content of interaction, creating a vibrant classroom atmosphere, promoting students to participate more actively in the learning process, and improving learning effectiveness.

The most important part is Real-Time Feedback Loops. Deep Seek ' s chatbot interface allows students to ask questions during and after class. For example, a student struggling with calculus theory can receive step-by-step explanations. If the student still has questions about the process, he can ask it for further explanation. The system will record your learning process and mark your persistent issues for teachers follow-up.

3.3 Reforming Student Assessment: Achieving Comprehensive Evaluation

The traditional evaluation of students in higher mathematics courses mainly relies on exam scores, and this single evaluation method cannot fully reflect students' learning process and comprehensive abilities. AI technology provides strong support for the innovation of student evaluation systems. Through the AI learning analysis system, various data of students during the learning process can be collected in real time, including classroom participation, homework completion, online discussion activity, test scores, etc. For example, the system can analyze students' mastery of various concepts based on their answers to different knowledge points in calculus assignments, draw detailed knowledge graphs, and visually display students' learning strengths and weaknesses[9]. In terms of exam evaluation, AI can assist teachers in designing diverse exam question types. In addition to traditional calculation and proof questions, AI can also introduce analysis and modeling questions based on practical application scenarios to more comprehensively test students' ability to apply knowledge. At the same time, using AI for intelligent grading not only improves the efficiency of grading, but also analyzes students' answers from multiple dimensions, such as innovative problem-solving ideas and rigorous logic. This student assessment based on multi-source data and diversified methods can more comprehensively, objectively, and accurately reflect students' learning status, provide scientific basis for teachers to adjust teaching strategies and students to improve learning methods, and promote the comprehensive development of students in higher mathematics learning.

4 The Application of DeepSeek in Higher Mathematics Teaching in Vocational Colleges

The integration of DeepSeek, which is a powerful AI tool, into teaching has brought new vitality and changes to higher mathematics teaching in vocational colleges, It plays a significant role in several key teaching aspects.

The first one is that it can facilitate knowledge visualization and reduce the learning threshold. students in vocational colleges often face great difficulties in understanding the abstract concepts of higher mathematics. DeepSeek, with its

excellent graphic processing and simulation capabilities, can visually present complex knowledge such as calculus. When explaining the concept of limits, teachers can use DeepSeek to create animations. For example, it shows how the value of the function $f(x)$ gradually approaches the limit value as the independent variable x infinitely approaches a certain constant a. In the animation, as the value of x continuously gets closer to a, the points on the function graph also move accordingly, which demonstrates the dynamic process of the function value infinitely approaching a specific numerical value. It helps students to intuitively make the essence of limits. For the partial derivatives of multi - variable functions, DeepSeek can use 3D modeling to present the rate of change of the function in different coordinate axis directions in a three - dimensional graph. For instance, when analyzing the binary function $z = f(x,y)$, by rotating the 3D model, students can observe the changing trends of the function in the x - direction and y - direction from different angles, and deeply understand the geometric meaning represented by partial derivatives[10]. This visual teaching method transforms abstract knowledge into specific and perceptible images, effectively reducing the learning threshold for students in vocational colleges to learn higher mathematics, stimulating their learning interest, and making the learning process more relaxed and efficient. The next one is promoting diversified teacher - student interaction and creating a lively classroom atmosphere. In classroom teaching, teachers can use DeepSeek to conduct real-time quizzes. Students answer questions through mobile devices such as mobile phones or tablets, and the DeepSeek system can complete grading in a short time and provide detailed feedback, including answering time, error types, etc. Teachers can quickly understand students' mastery of knowledge points based on the feedback and conduct immediate explanations.

It also improves a lot in student evaluation system.The AI learning analysis system supported by DeepSeek provides an effective way to solve this problem. This system can collect multi - dimensional data of students during the learning process in real time, covering classroom participation, homework completion, online discussion activity, and various test scores. Taking calculus homework as an example, the system can accurately analyze students' mastery of each concept and skill based on their answering situations for different knowledge points, such as limit operations, derivative solutions, and integral calculations, and draw a detailed knowledge map. From the map, teachers can clearly see students' advantageous knowledge points and existing weaknesses.

5 Successful Implementations in Higher Education-Zhejiang University ' s "Smart Classroom"

Zhejiang University has integrated DeepSeek into its "Wisdom ZJU" platform, and it provided AI tools for course-specific tutoring and interactive quizzes. Results showed a 22% improvement in calculus exam scores among freshmen, which is attributed to AI ' s ability to break down complex proofs into step by step analysis.

6 Conclusion

The application of AI in higher mathematics teaching in vocational colleges comprehensively optimizes the teaching process from knowledge visualization, teacher - student interaction to student evaluation. It is of great significance for improving teaching quality and promoting students' growth, and is a powerful tool for promoting the reform and innovation of higher mathematics teaching in vocational colleges. AI empowers educators to focus on high-impact mentorship while equipping students with the analytical skills demanded by Industry. Future research should explore hybrid models that balance AI efficiency with human creativity, ensuring ethical and sustainable adoption across vocational institutions.

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