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Exploring Strategic Pathways for AI-Empowered Personalized Mathematics Education in Liaoning Private Undergraduate Colleges and Universities

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Abstract: Since the official birth of the field of artificial intelligence in 1956, its development trajectory has consistently attracted widespread social attention and academic exploration. Mathematics, as the theoretical cornerstone of scientific research, plays a crucial role across various disciplines. For instance, in fields such as electronic communication and aerospace engineering, mathematical methods are essential for system modeling, simulation, and optimization. In light of this trend, private higher education institutions urgently need to break through traditional disciplinary barriers by establishing a cross-disciplinary platform that integrates artificial intelligence with mathematical foundations, transforming the deductive capabilities of theoretical models into tangible industrial outcomes. Both domestic and international research has made achievements in the application of artificial intelligence in personalized education and teacher-student interaction, yet there remain some critical research gaps. This paper provides a comprehensive and in-depth analysis of personalized education in mathematics courses at private higher education institutions, forming a systematic theoretical and practical framework.

Keywords: AI-Empowered; Private Undergraduate Colleges and Universities; Mathematics; Personalized education

1. Introduction

In 2017, the State Council issued the "New Generation Artificial Intelligence Development Plan", which for the first time included smart education in the national agenda. Family strategic development map[1]; subsequently, the Ministry of Education issued the "Education Informatization 2.0 Action Plan" in 2018, outlining the integration path of cutting-edge technology and teaching scenarios[2], injecting strong momentum into the modernization transformation of the education system. This synchronous resonance between policy guidance and technological evolution is reshaping the underlying logic of the traditional education ecosystem.

In China, research has shown a multidimensional development trend. In recent years, domestic scholars have conducted extensive studies on artificial intelligence and personalized education. Scholars such as Xu Miao have discussed the scientific nature, challenges and countermeasures of AI-enabled personalized education from theoretical, practical and realistic perspectives[3]. Scholar Feng Dongxue analyzed the value of artificial intelligence technology in personalized education in higher education, detailing AI-based personalized education models, including data-driven personalized learning analysis, intelligent personalized learning plan recommendations, and adaptive personalized learning progress adjustments[4]. Scholar Yue Qiwei systematically analyzed the impact of teacher-student interaction on college students' learning engagement in online learning and provided feasible suggestions to promote the quality of interaction between teachers and students, thereby enhancing college students' engagement in online learning[5].

Research abroad also has distinct characteristics. As early as the 1980s, studies in the United States and some European countries focused on the actual learning outcomes of students, using them as an important indicator for evaluating the quality of higher education. This evaluation standard also includes the extent of efforts made by schools to achieve students' learning goals[6]. The level of student engagement influenced by

teacher-student interaction serves as a core observational dimension for educational quality assessment[7] and student development monitoring[8], showing a significant correlation with academic achievement[9]. At the same time, student engagement, as a key variable triggering higher-order cognitive processes, not only provides a dynamic quantitative basis for academic evaluation systems but also serves as the core hub for constructing the "process quality assurance-outcome capability output" educational closed loop.

2. Investigation and Analysis of the Current Situation of AI Empowering Personalized Education in Private Colleges

This survey targets students and mathematics teachers in private colleges, collecting data through online questionnaires, with 1,319 valid responses from students. The student questionnaire covers basic information about students, their understanding of AI technology, usage frequency, commonly used tools, views on the role of AI, and challenges faced; the teacher questionnaire involves basic information about teachers, their understanding of AI technology, its application in teaching, views on the impact of AI, tools they hope to use, and challenges faced.

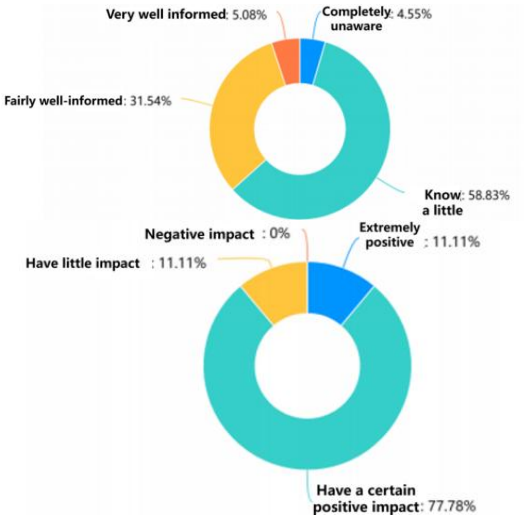

Figure 1. Student-Level and Teacher-Level Questionnaire Survey

As shown in Figure 1, at the student level, 58.83% of students indicated that they "know a little" about the application of AI technology in mathematics courses, 31.54% of students "know relatively well", only 5.08% of students "know very well", and 4.55% of students "know nothing at all", indicating that students have some awareness of AI technology, but the depth is insufficient; at the teacher level, 77.78% of teachers believe that AI technology has "some positive impact" on students' learning of mathematics, 11.11% believe it is "very positive", and no teachers believe it has a negative impact or is of little effect, affirming the positive role of AI technology.

3. The Deep Integration of AI Technology and Teacher-Student Interaction in Mathematics Education at Private Colleges

3.1 Interaction Motivation

Taking the "Advanced Mathematics" course at experimental private colleges as an example, some students actively consult teachers about course knowledge content in class, including behaviors such as voluntarily signing up for mathematics competition tutoring, which belong to internal interaction motivation; participating in the teacher's online after-class exercise tutoring as required every week belongs to external interaction motivation. Figure 2 shows the internal and external interaction motivations in the mathematics courses of experimental private colleges.

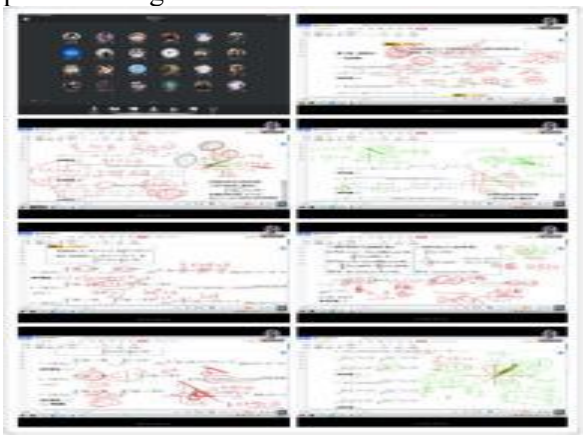

Figure 2. After-Class Tutoring (External Interaction Motivation)

3.2 Interaction Emotions

Taking the "Advanced Mathematics" course at experimental private colleges as an example, due to the complexity and difficulty of the course content, and the relatively weak foundation of the students, it is not recommended to adopt the traditional "full-class lecture" approach in the actual teaching of the "Advanced Mathematics" course. Instead, efforts should be made to engage students in the classroom. For example, students can be grouped before class, and after the new lesson is taught, discussions can be held

within groups, with one student selected to explain in front of the class, and the teacher providing feedback on the spot.

4. Deep Integration of AI Technology and Personalized Education in Mathematics at Private Colleges

Taking experimental private colleges as an example, the mathematics courses mainly include three required courses: “Advanced Mathematic”Linear Algebra”, and “Probability Theory and Mathematical Statistics”, along with one elective course: “Discrete Mathematics”. All required courses adopt an AI-empowered blended teaching model that combines online and offline methods.

The “Advanced Mathematics” course currently adopts a blended teaching model that integrates online and offline methods based on AI intelligent tools. Before class, students use the online platform to prepare, and during the preparation process, they can utilize AI study companions for answering questions; in class, teachers conduct offline lectures, and during the teaching process, they can use AI teaching companions to simultaneously translate the content of the lecture and record students’ questions; after class, students complete assignments and tests on the online platform while also participating in online knowledge discussions. As shown in Figure 3.

Figure 3. AI Teaching Assistant and AI Learning Companion

5. AI Empowered Pathways for Personalized Education in Private Higher Education Institutions

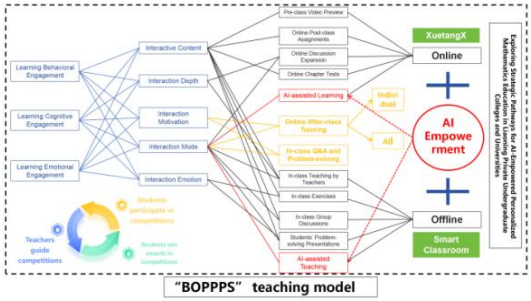

Figure 4. AI Empowered Pathways Model for Personalized Education in Private Higher Education Institutions

Based on the content of this topic and the actual teaching of the "Advanced Mathematics" course in experimental private higher education institutions, a model for AI-empowered personalized education pathways in mathematics has been constructed, as shown in Figure 4.

6. Conclusion

This paper systematically demonstrates the feasibility and implementation pathways of AI in personalized education in private higher education institutions, optimizing teacher-student interaction and enhancing the relevance of teaching through technological empowerment. In the future, it is necessary to further promote the deep integration of AI tools with course content, strengthen technical training for teachers, and build a “data-teaching-evaluation” closed loop, providing practical examples for the digital transformation of higher education in private institutions.

Acknowledgements

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