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Theoretical Foundation on the Optimization of College English Classroom Teaching Methods Based on Learning Data

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Abstract: This paper explores the theoretical foundation for optimizing college English classroom teaching methods through the application of learning data, with a focus on Hainan University of Science and Technology. The study emphasizes the significance of enhancing the quality of higher education, supporting talent cultivation for the Hainan Free Trade Port, and advancing individualized and data-driven teaching practices. By analyzing domestic and international research on learning data analytics, real-time feedback systems, and personalized learning pathways, the paper identifies key opportunities for leveraging data to improve teaching effectiveness and foster students' self-learning abilities and motivation. It also highlights the potential for digital transformation in education and provides replicable case studies to inform broader teaching reforms. Supported by a key project grant, this research contributes to the growing body of knowledge on data-driven instructional optimization in higher education.

1. Research Significance

1.1 Enhancing the Quality of Higher Education at Hainan University of Science and Technology and Supporting Talent Cultivation for the Free Trade Port

Hainan is accelerating the development of its Free Trade Port, leading to a growing demand for international and application-oriented talents. As a critical tool for globalization, English is an essential skill for Hainan university students to enter the international market and engage in global communication. Improving college students' English proficiency has thus become a key goal for Hainan universities. This research project aims to optimize college English teaching methods through learning data analysis, enhancing students' English language skills and cultivating more internationally competitive professionals. This aligns with the strategic needs of Hainan's Free Trade Port development.

1.2 Promoting Individualized Teaching and Achieving Effective Use of Teaching Resources

Students at Hainan University of Science and Technology (HUST) display varying levels of English proficiency. Some students, particularly those from remote areas, have relatively weak foundations in English, often facing greater challenges after entering university. This research seeks to use data analysis techniques to understand the learning performance and needs of different student groups and identify teaching methods suitable for them, thereby achieving personalized education. Teachers can adjust their teaching strategies based on data feedback, ensuring that every student receives appropriate learning support and maximizing the use of classroom resources.

1.3 Improving Classroom Teaching Effectiveness Through Data-Driven Instructional Reforms

Traditional college English teaching methods rely heavily on teacher-centered lectures, resulting in low student engagement and challenges in measuring teaching outcomes. This study collects and analyzes classroom data to provide evidence-based support for teaching decisions. It helps educators identify the strengths and weaknesses of various teaching methods and adopt those that better meet students' needs. Data-driven teaching optimizations can increase classroom interactivity and student engagement while enabling teachers to track students' learning progress in real time and adjust the teaching pace as needed, thereby improving overall classroom teaching effectiveness.

1.4 Cultivating Students' Self-Learning Abilities and Motivation

Many students lack intrinsic motivation and autonomous learning abilities in English. In traditional classroom settings, students are often passive recipients of knowledge and lack personalized learning support. By establishing a learning data feedback system, students can understand their learning progress and weaknesses, helping them set clearer goals and boosting their sense of self-efficacy. With optimized teaching methods, students will gradually transition from passive to active learning, enhancing their academic performance during university.

1.5 Providing Replicable Case Studies and Practical Experience for Teaching Reform at HUST

The findings of this research will provide valuable insights for the reform of college English teaching at HUST. The optimization of classroom teaching based on data analysis is an innovative approach, and its outcomes can be applied to other institutions, enabling more English teachers to adopt data-driven teaching strategies in their classrooms. This will further promote the digitalization and intelligence of teaching across universities in Hainan, injecting new momentum into educational innovation for the Free Trade Port.

1.6 Promoting Educational Digitalization and Informationization Transformation

With the gradual improvement of HUST's educational informationization, utilizing learning data analysis to enhance teaching has become an inevitable trend in digital education transformation. This study explores the practical application of data collection and analysis in classroom teaching, enriching the use of information technology in college English classes while promoting the effective management and utilization of teaching data. It provides a feasible case study for data-driven teaching in HUST's education system, advancing the process of educational digitalization and aligning teaching effectiveness with students' needs.

2. Analysis of Domestic and International Research Status

2.1 International Research Status

Globally, the optimization of classroom teaching driven by learning data has gradually become a hot topic in educational reform. In recent years, significant progress has been made in areas such as "Learning Analytics," real-time feedback systems, and personalized learning pathways.

2.1.1 Learning Data Analysis and Application

Learning Analytics (LA) has emerged as a cutting-edge direction in education and is widely applied in higher education. Jisc published several reports emphasizing the importance of using learning data to enhance students' academic performance and experience[1]. They proposed a "Predictive Analytics" framework for identifying and predicting learning risks, providing data-driven support for personalized teaching decisions. Another study demonstrated that visualizing learning data enables teachers to quickly understand students' learning status, optimizing classroom interactions and teaching strategies[2]. Canadian researchers Wang et al. suggested that learning data analysis helps educators identify students' learning barriers for timely interventions[3]. By combining data analysis tools and visualization technologies, teachers can monitor student performance in real-time and improve course design to create a more interactive learning experience.

2.1.2 Establishment of Real-Time Feedback Systems

Real-time feedback systems have become increasingly popular in university classrooms in Europe and North America. According to a 2021 survey by the American education technology research organization EDUCAUSE, real-time feedback systems allow students to immediately understand their performance after classroom activities, strengthening their self-directed learning abilities. These systems also help teachers monitor classroom dynamics in real-time and adjust teaching content based on students' feedback. The UK Open University developed the OU Analyse system, a representative learning analytics tool that monitors student progress, analyzing data such as attendance, assignment completion, and exam results to provide real-time feedback. Using such systems, teachers can identify struggling students and offer personalized support, thereby improving classroom efficiency.

2.1.3 Optimization of Personalized Learning Pathways

The optimization of personalized learning pathways has become a key focus of learning data analysis. The University of Helsinki in Finland developed an adaptive learning platform based on learning data that analyzes students' learning behaviors to generate personalized learning pathways. Studies have shown that such pathways not only enhance students' academic performance but also improve their engagement and motivation. Additionally, recent research by the University of Toronto in Canada demonstrated that data-driven learning pathway optimization systems significantly improve students' foreign language learning, particularly in reading comprehension and vocabulary acquisition[4].

2.2 Domestic Research Status

2.2.1 Classroom Learning Data Collection and Analysis

As "smart campus" initiatives gain traction, Chinese universities have gradually begun applying

learning data analysis technologies in classrooms. Researchers like Wang Zhiwei from Fudan University studied the application of learning data in classrooms and noted that behavioral data can help teachers better understand students' learning status, improving the scientific nature of teaching decisions[5]. By analyzing behavioral data, teachers can monitor students' learning progress, engagement, and satisfaction, thus optimizing teaching methods. Li Xiaojun developed a "Learning Behavior Data Analysis System," which has been piloted in multiple universities[5]. The research demonstrated that analyzing data such as classroom interaction and assignment completion significantly improves classroom participation and student performance. Furthermore, the research found that learning data analysis helps teachers identify common issues, providing a basis for group teaching strategies.

2.2.2 Data-Based Teaching Feedback Systems

Research on real-time feedback systems is gaining traction in China. Sun Min proposed a "Adaptive Teaching System" based on data feedback, which generates real-time reports by collecting students' classroom performance data[6]. This system not only boosts students' learning enthusiasm but also helps teachers monitor their progress. Liu Xiaohong found that real-time feedback systems are particularly effective in college English classrooms, significantly improving students' understanding and mastery of course content[7]. Data-based feedback systems allow testing of student responses to different teaching methods, thereby optimizing teaching strategies. Feedback-driven personalized teaching has proven feasible, effectively enhancing students' learning motivation and classroom engagement[8].

2.2.3 Personalized Learning Support and Stratified Teaching

Chinese universities have recently intensified their exploration of personalized learning support, especially by applying stratified teaching and data-driven learning pathways in college English instruction. Wang Liping proposed a data-driven stratified teaching model that matches students with different learning resources through learning data analysis[9]. The study showed that this stratified teaching approach significantly improved students' learning efficiency, particularly for those with weaker foundations. Xu Wenjuan further explored the practical application of personalized learning pathways in college English courses[10]. By analyzing data, personalized learning recommendations were provided to students of varying levels, optimizing their learning experience and outcomes. The research demonstrated that this personalized support model significantly improved students' reading and writing skills.

2.3 Comparative Analysis of Domestic and International Research

2.3.1 Technology Application

Foreign universities exhibit a higher level of maturity in applying learning analytics and feedback systems, supported by comprehensive technical frameworks and systematic data analysis tools. In contrast, domestic applications still lag, primarily relying on intelligent learning platforms for data collection, with room for improvement in technical development.

2.3.2 Research Focus

International research spans multiple disciplines, especially in STEM fields such as mathematics and physics. In contrast, domestic studies increasingly focus on language classrooms, particularly in college English, where data analytics is used to explore personalized learning pathways and

stratified teaching effectiveness.

2.3.3 Practical Application

Foreign research has gradually developed systematic applications for learning data, whereas domestic studies are still in the exploratory phase of classroom feedback and data-driven optimizations. Domestic research emphasizes improving teaching methods and verifying real-time student feedback but still requires further development in systematic applications of teaching data.

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