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Research on the Application Path of Artificial Intelligence Technology in Classroom Teaching in Higher Education

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Abstract: The in-depth advancement of educational digitization has effectively driven systemic changes in classroom teaching models in higher education institutions, prompting a gradual transformation of traditional classrooms towards deep integration with artificial intelligence (AI) in terms of teaching philosophy, mode, and content. The application of AI technology in teaching not only enriches the supply of teaching resources, optimizes the classroom teaching environment, and enhances teaching efficiency, but also effectively reduces the repetitive workload of teachers. It addresses prominent issues in traditional teaching, such as rigid teaching models, low teaching efficiency, and single evaluation methods, promoting a transformation towards personalized, intelligent, and precise teaching models. However, the current application and development of AI technology in higher education teaching practices remain imperfect, facing numerous practical challenges during implementation. Based on this, this paper systematically analyzes the application value of AI technology in classroom teaching in higher education and explores effective application paths, aiming to provide theoretical support and practical references for the high-quality development of classroom teaching in higher education in the new era.

Keywords: Artificial intelligence technology; Classroom teaching in higher education; Quality and efficiency enhancement; Innovation empowerment; Educational transformation

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1. Introduction

Against the backdrop of continuous iteration and upgrading of information technology, artificial intelligence (AI) has emerged as the core technology leading a new round of technological revolution and is gradually being deeply integrated into the process of educational reform. In recent years, multiple national policy documents on educational development have listed “AI-empowered educational transformation” as an important aspect of educational modernization, promoting the practical application and exploration of AI technology in teaching scenarios. Meanwhile, as a crucial link in talent cultivation, the quality of classroom

teaching in higher education directly relates to the effectiveness and core competitiveness of talent cultivation [1]. To ensure that the talent cultivation objectives of higher education institutions remain highly aligned with national strategies and societal needs, classroom teaching must shift from traditional teaching philosophies and models, relying on AI technology to drive systemic innovation and quality improvement in teaching models. Based on this, this paper focuses on the application of AI technology in classroom teaching in higher education institutions, delving into its application value and practical paths to provide references for advancing educational reform in higher education.

2. The application value of artificial intelligence technology in higher education classroom teaching

2.1. Improving quality and efficiency, optimizing teaching models

The application of artificial intelligence technology in higher education classroom teaching can effectively enhance quality and efficiency, alleviating the issue of low teaching efficiency in traditional universities. Firstly, AI can automate repetitive tasks such as courseware generation, homework grading, and student performance statistics, helping teachers save significant time on lesson preparation and grading, allowing them to devote more energy to instructional design, tackling difficult points, and educational research. Secondly, AI can monitor classroom atmosphere and student learning states in real time, providing teachers with effective bases for post-class reflection, thereby optimizing teaching activities and processes and enhancing teaching effectiveness [2]. Additionally, AI can automatically collect and analyze student learning data, accurately identifying knowledge weaknesses and providing data support for teachers to implement tiered teaching and personalized guidance. For example, in the course “Database Principles and Applications,” AI can automatically grade SQL statement assignments, tally syntax error types, helping teachers quickly identify common issues among students and improve teaching targeting.

2.2. Precise adaptation, promoting holistic development

Modern higher education has shifted from cultivating single-specialty professionals to nurturing composite and innovative talents. Traditional large-class teaching models struggle to accommodate individual differences, often falling short in tailored instruction and content relevance. AI technology can precisely capture students’ learning states, progress, ability levels, and actual needs in the classroom, generating personalized learning paths and coaching plans through data analysis, helping students precisely address weaknesses, expand knowledge boundaries, and enhance comprehensive abilities. Meanwhile, teachers can leverage AI technology to efficiently design more engaging teaching activities and processes, effectively enhancing classroom interaction and alleviating the challenges of insufficient teacher-student interaction and delayed feedback in traditional teaching [3]. Furthermore, AI can serve as an intelligent learning assistant, providing students with instant answers, step-by-step breakdowns, visual demonstrations, and other supports, transforming abstract knowledge into concrete concepts and improving comprehension efficiency. For instance, in the course “Database Principles and Applications,” when students encounter difficulties with SQL syntax, multi-table joins, or normal form judgments, they can use AI to obtain problem-solving approaches, step-by-step breakdowns, and logical explanations, converting abstract theories into understandable structured content and significantly improving learning efficiency. Additionally, AI can expand learning resources based on students’ abilities and interests, guiding inquiry-based learning and

strengthening innovative thinking training, providing strong support for the realization of comprehensive talent cultivation goals in universities.

2.3. Innovation empowerment, driving educational transformation

The application of artificial intelligence technology in higher education classroom teaching has promoted the transformation and upgrading of traditional teaching philosophies, driving a gradual shift from a score-centric evaluation model to a competence- and literacy-oriented quality education model. Firstly, AI technology breaks the limitations of traditional "one-size-fits-all" teaching, promoting the development of teaching models towards personalization and precision, enabling students to engage in autonomous learning based on their own foundations and learning paces, achieving more efficient learning experiences driven by interest. Secondly, AI technology helps teachers and students stay abreast of cutting-edge knowledge and industry developments in their professional fields in real time, effectively makes up for the lag in textbook content updates and its disconnect from industry realities, significantly enhancing the forward-lookingness and applicability of teaching content. Thirdly, AI technology provides strong support for teaching method innovation, allowing teachers to more aptly integrate real-world enterprise project cases into the classroom and structurally dissect these cases through big data analysis, guiding students to explore layer by layer and practice step by step, strengthening practical ability and engineering thinking training [4]. For example, in the course "Database Principles and Applications," AI can assist in completing data modeling and solution optimization for real-world business scenarios, helping students accomplish practical tasks such as automatic E-R diagram generation, SQL execution plan analysis, and database performance diagnosis, enabling them to enhance their application abilities in an environment close to engineering practice. Meanwhile, AI supports the conduct of virtual simulation experiments, capable of replacing some high-risk, high-cost, or difficult-to-implement experimental projects on-site, providing important guarantees for the reform and quality improvement of practical teaching in universities.

3. Application paths of AI technology in higher education classroom teaching

3.1. Pre-class preparation stage: Intelligent empowerment for precise foundation-laying

Pre-class preparation is a crucial prerequisite for ensuring orderly and efficient classroom teaching, with thorough and precise teaching preparations directly determining the quality of classroom instruction. The in-depth application of AI technology during the pre-class phase enables intelligent upgrades across the entire process, focusing on four key dimensions: student learning condition diagnosis, resource provision, instructional design, and preliminary foundation-laying, thereby laying a solid foundation for efficient classroom implementation. AI can intelligently analyze students' prior knowledge mastery, completion of preview tasks, preview assessment results, and historical learning data, accurately identifying students' knowledge weaknesses and ability levels. Subsequently, it automatically delivers personalized preview materials, micro-lecture videos, and tiered exercises, enabling students to complete foundational preparation and identify gaps before class. For instance, teachers can utilize learning platforms (such as Xuexi Tong) to conduct student learning condition diagnoses, integrating data on preview progress, answer accuracy rates, and common error-prone knowledge points to quickly identify collective class issues, clarify key and difficult points in classroom teaching, and achieve precise alignment between teaching content and student learning

conditions, effectively implementing personalized instruction [5]. Meanwhile, during teacher lesson planning, AI can automatically generate multiple differentiated lesson plans, courseware, classroom case studies, and interactive designs based on course objectives, teaching content, and student learning condition analysis results, significantly reducing repetitive work for teachers and enhancing lesson planning efficiency. AI can also preemptively predict classroom difficulties, recommending visual materials, demonstration animations, and step-by-step explanation ideas for abstract and challenging knowledge points, while synchronizing industry-leading technologies and the latest application cases to compensate for the lag in textbook content updates, enhancing the forward-looking and practical nature of teaching. Furthermore, AI can intelligently generate experimental task sheets, classroom challenge tasks, and group discussion topics, completing difficulty assessments and process simulations of classroom tasks to assist teachers in optimizing classroom rhythm and task design. Through comprehensive AI empowerment, pre-class preparation shifts from experience-driven to data-driven, and from uniform arrangements to precise adaptation, not only building a gentle learning ladder for students but also providing teachers with scientific, efficient, and flexible lesson planning support, significantly enhancing the targeted and effective nature of classroom teaching.

3.2. In-class implementation stage: Intelligent interaction for quality and efficiency enhancement

In higher education classroom teaching, the classroom implementation phase is particularly critical. Teachers need to dynamically adjust teaching plans based on student learning conditions, teaching objectives, and classroom atmosphere, strengthening teacher-student interaction, invigorating the classroom atmosphere, and fully mobilizing students' learning enthusiasm. The in-depth application of AI technology during the classroom implementation phase can serve as an intelligent teaching assistant to help teachers optimize the teaching process, facilitating a shift from traditional one-way knowledge delivery to a new teaching model that deeply integrates theory and practice [6]. In theoretical teaching, AI can rapidly generate typical case studies matching knowledge points, transforming abstract and dry professional content into intuitive and understandable practical scenarios, effectively improving teaching effectiveness. For example, in the course "Database Principles and Applications," AI can generate SQL examples, query execution plans, and index optimization scenarios in real time, helping students quickly grasp complex principles. Simultaneously, in practical teaching, AI can construct virtual operating environments, guiding students through hands-on training and providing real-time verification, error correction, and guidance during the operational process, strengthening students' knowledge application abilities. After training, AI can objectively evaluate students' practical performance, accurately pointing out issues and deficiencies to assist students in continuous improvement.

Additionally, AI can upgrade traditional classroom interaction models into multi-dimensional, stereoscopic interaction systems. First, AI can capture students' classroom states in real time, assessing learning effectiveness through behavioral and participation data analysis, and providing timely feedback to teachers to facilitate adjustments in teaching pace and methods, enhancing student concentration. Second, AI can effectively expand teacher-student interaction by asking follow-up and supplementary questions based on student responses, guiding students in in-depth thinking and strengthening mental training. Third, AI can participate as a virtual member in group discussions, raising questions, supplementing ideas, or correcting deviations based on student viewpoints, ensuring the depth and scientific nature of group discussions,

significantly improving classroom interaction quality and learning effectiveness [7].

3.3. Post-class consolidation stage: Intelligent extension for effect enhancement

Post-class consolidation is a key phase for internalizing and absorbing classroom knowledge and identifying and filling gaps, playing a crucial role in enhancing learning effectiveness. AI technology can construct an intelligent post-class learning closed loop, providing integrated services for knowledge review, personalized practice, automatic grading, and instant Q&A. AI can automatically organize classroom knowledge structures, generating mind maps, key and difficult point lists, and knowledge pathway diagrams to help students quickly review classroom content and strengthen overall cognition. Based on multi-dimensional data such as students' pre-class preview performance, classroom performance, and exercise completion, AI can generate precise learning profiles, delivering differentiated review materials and tiered exercises to students of different levels, ensuring that students with weak foundations consolidate core knowledge points while assisting more capable students in expansion and improvement. After students complete exercises, AI can automatically grade, score, categorize incorrect answers, and analyze error causes, delivering targeted supplementary exercises of the same type to help students strengthen weak areas and eliminate knowledge gaps [8]. Furthermore, AI provides round-the-clock intelligent Q&A services, allowing students to consult anytime they encounter confusion after class, receiving step-by-step explanations, thought guidance, and expanded explanations, effectively addressing issues of delayed after-class Q&A and poor communication in traditional teaching. Through intelligent extension and continuous support from AI, post-class learning shifts from passive completion to active improvement and from uniform tasks to precise consolidation, significantly enhancing learning effectiveness and learning autonomy.

3.4. Evaluation and feedback stage: Intelligent empowerment for scientific and fair assessment

Teaching evaluation serves as a crucial basis for improving teaching methods, enhancing teaching quality, and promoting student development. Traditional teaching evaluations, often result-oriented, suffer from issues such as a single evaluation subject, one-sided dimensions, and strong subjectivity. AI technology can construct a comprehensive, multi-dimensional, and data-driven intelligent evaluation system, making evaluations more objective, comprehensive, and scientific. For students, AI can automatically collect full-process learning data such as preview performance, classroom interaction, assignment completion, experimental operations, and stage tests, forming a complete and authentic learning growth trajectory, conducting comprehensive evaluations from multiple perspectives such as knowledge mastery, ability enhancement, and literacy development, breaking away from the "sole focus on scores" and more truly reflecting students' learning states and progress [9]. For teachers, AI can analyze teaching behavior data such as instructional design, classroom organization, interaction effectiveness, and guidance quality, forming objective teaching diagnosis reports to help teachers identify teaching weaknesses, optimize teaching strategies, and enhance teaching abilities [10]. Simultaneously, AI can significantly improve evaluation efficiency, automatically completing objective question grading, experimental result verification, and data statistical analysis, reducing manual workload and minimizing human errors, enabling more timely feedback and precise evaluations. With the aid of AI technology, teaching evaluations shift from singularity to diversity, from subjectivity to objectivity, and from lag to timeliness, providing clear guidance for student growth and scientific support for teacher teaching

improvements, ultimately driving continuous enhancement in classroom teaching quality.

4. Conclusion

In summary, the in-depth application of AI technology in higher education classroom teaching represents a crucial path for promoting higher education teaching reform and enhancing classroom teaching quality. AI technology can permeate the entire process of pre-class, in-class, post-class, and teaching evaluation, precisely addressing real-world challenges in traditional teaching such as low efficiency, insufficient interaction, weak personalized instruction, and single evaluation methods, providing intelligent support for teacher teaching and student learning, facilitating students' all-around development, and driving the transformation of higher education models towards personalization, intelligence, and precision. However, the current integration of AI and classroom teaching remains in the preliminary exploration stage, with insufficient integration depth and relatively limited application scenarios, and numerous issues still exist in practice. Notably, some teachers lack proficiency in applying AI for teaching, making it difficult to fully leverage the empowering effects of technology; simultaneously, some students develop excessive reliance on AI tools, weakening their autonomous thinking and exploration abilities. These issues, to a certain extent, constrain the long-term development of AI-integrated teaching.

Therefore, future efforts must further deepen the fusion and innovation of AI and higher education: on the one hand, strengthening the construction of a composite faculty team to enhance teachers' AI technology application and instructional design capabilities; on the other hand, guiding students to use AI tools reasonably, avoiding excessive reliance, and strengthening autonomous learning awareness; while continuously promoting functional optimization and scenario expansion of intelligent teaching systems to drive deep integration of technology and teaching. Through collaborative efforts from multiple parties, continuously empowering higher education teaching reform and promoting the high-quality development of higher education.

Disclosure statement

The authors declare no conflict of interest.

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