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Research on the Innovation of College English Flipped Classroom Supported by AI Technology

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Abstract: With the advancement of educational digitalization, flipped classrooms have been widely adopted in college English teaching. Nevertheless, they still face prominent practical dilemmas, including insufficient localized adaptation, low efficiency in students' independent learning, excessive teachers' workload, and lagging resource and evaluation systems. Taking AI-enabled smart teaching as the research entry point, this paper summarizes its four core advantages: hierarchical and precise teaching, all-weather intelligent learning support, workload reduction via human-machine collaboration, and full-scale data-driven evaluation. It further defines five progressive construction objectives, covering localized teaching implementation, language competence cultivation, the improvement of teachers' digital literacy, the optimization of long-term supporting mechanisms, and digital-oriented talent cultivation. Based on the closed-loop three-stage teaching process of pre-class preparation, in-class exploration and after-class consolidation, this paper proposes innovative reform paths from four aspects: differentiated teaching design, intelligent independent learning systems, human-machine collaborative teaching modes, and optimized digital guarantee mechanisms. This study aims to address the practical bottlenecks of flipped classroom implementation with the support of artificial intelligence, construct a localized and sustainable smart teaching model for college English instruction, and comprehensively enhance students' comprehensive English application competence.

Keywords: Artificial Intelligence; College English; Flipped Classroom; Teaching Innovation.

1. Introduction

Educational digitalization constitutes the core direction of higher education reform in the new era. In 2025, the Ministry of Education issued the Opinions on Accelerating the Advancement of Educational Digitalization, which takes educational digitalization as a crucial breakthrough to comprehensively support the construction of an education power [1]. The document clearly defines "comprehensively promoting intelligent transformation and boosting educational reform through artificial intelligence" as one of its three major development directions, providing policy basis and practical guidance for higher education reform. As a core public basic course in higher education, college English teaching should conform to the trend of digital reform and reshape classroom forms relying on intelligent technologies. As a mature blended teaching model, the flipped classroom effectively transforms the traditional teacher-centered lecturing model, highlights students' dominant role in independent inquiry learning, and has been widely applied in college English teaching practice. Emerging teaching modes such as the flipped classroom for college English have increasingly become a normal developmental trend of educational informatization [2]. Against this backdrop, this paper explores how to further leverage the key role of AI technology in promoting the innovation of college English flipped classrooms, so as to achieve the dual goals of improving students' comprehensive language application ability and enhancing classroom teaching quality [3].

2. Development Dilemmas of the Flipped Classroom

Also known as the inverted classroom, the flipped classroom is an innovative information-based teaching model that reconstructs traditional teaching procedures. It applies network information technology to reverse the traditional teaching logic from "teaching before learning" to "learning before teaching", thereby transferring the ownership of learning from teachers to students [4]. Different from the conventional teaching logic of "knowledge lecturing in class and knowledge consolidation through after-class homework", the flipped classroom reverses the time and space of the two core teaching links: knowledge transmission and knowledge internalization. Specifically, students independently complete the preliminary learning of new knowledge through digital resources such as micro-lessons, courseware and reading materials before class to grasp basic knowledge. In-class time is no longer occupied by one-way knowledge indoctrination, but focuses on in-depth learning activities including teacher-student interaction, group collaboration, problem inquiry and key and difficult point Q&A, so as to realize the digestion, consolidation and sublimation of knowledge. The core of the flipped classroom is not a simple reversal of teaching procedures, but a fundamental reform of teaching concepts and teacher-student relationships. Essentially, it weakens teachers' role as knowledge indoctrinators and strengthens students' dominant position in learning. It transforms the passive teaching mode of "teachers determine teaching content and students receive knowledge passively" into an active mode of "students learn according to their needs with targeted teacher guidance", realizing the teaching objectives of precise and efficient learning. Adhering to the student-centered educational philosophy, the flipped classroom realizes personalized learning through teacher-student and student-student interactions, and encourages students to participate in classroom activities and complete learning tasks collaboratively [5].

The concept of the flipped classroom can be traced back to the 1990s. In 1991, Professor Eric Mazur, an applied physicist at Harvard University, first proposed that computer technology could effectively empower teaching innovation

and provide technical and theoretical support for the transformation of classroom teaching modes, laying an early research foundation for the formation of the flipped classroom model [6]. In 2007, Woodland Park High School in Colorado, the United States, took the lead in exploring and implementing the flipped classroom teaching model, marking the formal transformation of the flipped classroom from theoretical conception to practical teaching application [4]. With the widespread popularity of Khan Academy, the influence of the flipped classroom rapidly expanded across the United States and the globe. In 2012, the vigorous development of massive open online courses (MOOCs) further popularized the flipped classroom worldwide, triggering an upsurge of classroom teaching reform, impacting traditional classroom teaching modes, and sparking a new round of classroom teaching innovation [7]. As the flipped classroom gradually matured in foreign teaching systems, it was introduced into China and widely applied in the reform of college English teaching.

However, originating from Western educational contexts, the flipped classroom has obvious incompatibilities with China's teaching philosophies, student learning characteristics, classroom atmosphere and teaching systems, resulting in prominent localization adaptation problems after its introduction. Existing academic studies have identified numerous practical difficulties in its domestic implementation. Chen Yan pointed out that college English flipped classrooms in China generally suffer from low compatibility of teaching concepts between teachers and students, insufficient teachers' information literacy, and imperfect procedural teaching evaluation systems [3]. From a temporal perspective, Guo Ruiying and other researchers argued that the unique virtual teaching time of the flipped classroom conflicts with domestic school management systems and teachers' and students' time management modes, leading to teachers' heavy workloads and students' chaotic time allocation [8]. At this stage, the localized practice of flipped classrooms in China is restricted by multiple intertwined factors, resulting in superficial teaching reforms and failure to achieve expected educational outcomes. First, the teaching model lacks localized adaptation with prominent formalization problems. Many frontline teachers merely copy the superficial procedures of pre-class micro-lesson viewing and in-class group discussions, without designing differentiated inquiry tasks suitable for large-class teaching in China. The blind adoption of foreign teaching frameworks is inconsistent with local students' learning characteristics, making in-depth knowledge internalization impossible. Second, students' independent learning systems have inherent defects, leading to prominent learning differentiation and excessive academic burden. Accustomed to passive knowledge reception, most students lack independent learning planning abilities. Unreasonable preview tasks increase students' cognitive load, and excellent students tend to dominate group activities while underachievers are marginalized, widening the academic gap. Third, teachers' insufficient digital literacy and excessive workload reduce their enthusiasm for reform. The implementation of flipped classrooms requires continuous micro-lesson development, learning situation tracking and differentiated tutoring, but most teachers lack systematic technical training. The heavy additional teaching tasks lead to job burnout, and traditional teaching thinking further restricts their initiative in reform. Fourth, the construction of teaching resources, evaluation systems and supporting mechanisms lags behind. High-quality school-based resources are scarce and lack sharing channels; teaching evaluation still focuses on final examination scores without full-process quantitative assessment; grassroots schools lack adequate hardware facilities and teaching research incentive systems, failing to provide long-term operational support.

3. Advantages and Construction Objectives of AI-enabled Smart Teaching

Since the implementation of the Education Informatization 2.0 Action Plan, China has achieved full coverage of educational infrastructure and online teaching resources, and is currently in a transitional stage from the in-depth implementation of Education Informatization 2.0 to comprehensive digital and intelligent education. Emerging technologies such as artificial intelligence and big data have become core supports for solving the practical dilemmas of flipped classroom implementation and promoting teaching model innovation [9][1]. The traditional college English flipped classroom is hindered by numerous practical problems including formalized teaching, poor independent learning effects, excessive teacher workload, and imperfect resource and evaluation mechanisms, which restrict the educational value of teaching reform. In this context, the smart teaching model built on artificial intelligence and big data can targeted resolve the inherent contradictions of traditional flipped classrooms and clarify the development direction of college English classroom transformation.

The compatibility of AI-enabled smart teaching with college English flipped classroom reform lies in its ability to make up for the insurmountable deficiencies of traditional teaching models, with four core advantages. First, based on massive learning data, AI constructs exclusive learning portraits for each student to realize hierarchical and precise teaching. This effectively addresses the challenges of large-class teaching and uneven students' English proficiency, avoiding the mechanical copying of foreign small-class flipped teaching procedures and eliminating formalized teaching [10]. Second, the AI system provides all-weather online learning assistance. Students can obtain timely tutoring on grammar and speaking problems during pre-class preview and after-class extended practice. The platform reasonably regulates the total amount of learning tasks to avoid excessive academic pressure caused by overlapping multidisciplinary assignments, and alleviates the learning differentiation phenomenon in group discussions [11]. Third, artificial intelligence undertakes repetitive work such as micro-lesson production, exercise correction and learning data statistics, freeing teachers from mechanical trivialities. Rich digital teaching cases on the platform also compensate for teachers' insufficient digital teaching abilities and reduce job burnout caused by teaching reform [12]. Fourth, the platform integrates English teaching resources from various schools in the region to build a dynamically updated shared resource library and avoid repeated resource development. Meanwhile, it records students' full-process learning behaviors to establish a multiple evaluation system combining process performance and final examination results, laying institutional and resource foundations for the sustainable development of flipped classrooms.

AI technology is only an auxiliary tool for teaching reform.

The construction of an AI-enabled smart teaching system focuses on establishing progressive development objectives centered on college English talent cultivation, which is the fundamental purpose of optimizing flipped classrooms via AI technology.

Basic Implementation Objective: Eliminate formalized teaching and realize localized adaptation of flipped classrooms. Most current college flipped classrooms merely copy the fixed procedure of "pre-class video viewing and in-class group discussion", without adapting to the domestic context of large-class teaching and students' weak independent learning awareness, resulting in superficial reform [3]. The primary objective of smart teaching construction is to reconstruct the complete teaching chain of pre-class independent learning, in-class inquiry and after-class consolidation through adaptive digital tools. It designs differentiated learning tasks in line with the comprehensive training requirements of college English listening, speaking, reading and writing, replacing unified teaching arrangements with localized flipped classroom models adapted to domestic learning conditions, so as to integrate flipped teaching into daily education rather than formal inspection-oriented practices [13].

Core Educational Objective: Cultivate students' independent learning ability and comprehensive language application competence. Under the long-term traditional lecture-based teaching model, students are accustomed to passive knowledge reception, lacking awareness of independent planning and active inquiry, resulting in perfunctory preview and weak oral expression and logical thinking abilities. The smart teaching system adopts personalized learning guidance, virtual oral practice and differentiated extended materials to help students develop the habit of independent preview and review. Hierarchical task design enables underachievers to make up for deficiencies and high-level students to achieve advanced improvement, narrowing the internal proficiency gap of the class. This objective focuses not only on improving students' written test scores, but also on cultivating their language communication ability and lifelong learning literacy including active thinking and cooperative competence, which meets the core requirements of foreign language talent cultivation in the new era.

Teacher Development Objective: Reshape teacher-student roles and promote teachers' digital professional growth. Traditional flipped classrooms greatly increase teachers' workload in lesson preparation, resource development and personalized tutoring. Most teachers without systematic digital training tend to resist new teaching modes. An important objective of smart teaching construction is to build a new human-machine collaborative teaching model. AI undertakes mechanical work such as objective question correction and data statistics to free teachers' time. The platform provides systematic digital teaching courses and excellent flipped classroom cases to gradually improve teachers' abilities in digital teaching design and dynamic classroom management. It promotes the transformation of teachers from pure knowledge lecturers to learning guides and personalized growth companions, fundamentally enhancing teachers' initiative in participating in teaching reform [14].

Long-term Guarantee Objective: Build an integrated digital teaching supporting system to ensure the normalized operation of flipped classrooms. The scarcity of high-quality school-based resources, single evaluation criteria and insufficient school hardware and software facilities are key obstacles to the sustainable development of flipped classrooms. Therefore, smart teaching construction needs to improve supporting mechanisms synchronously. On the one hand, an inter-school dynamic English resource sharing platform is built to continuously update listening, reading and writing materials adapted to local teaching progress and reduce repeated resource development. On the other hand, a dual evaluation mechanism combining "process performance assessment + final comprehensive assessment" is established based on full-process learning data, reversing the exam-oriented evaluation that solely focuses on final scores. Meanwhile, lightweight cloud teaching platforms lower the hardware threshold for grassroots colleges. Automatically generated learning situation reports provide data support for schools' teaching research and teacher incentive policies, forming a long-term guarantee system integrating resources, evaluation and management mechanisms.

Top-level Ultimate Objective: Adhere to student-centered smart education philosophy and boost the overall digital transformation of education. The ultimate goal of smart teaching construction is not the simple introduction of intelligent equipment, but the balance between the instrumental value of technology and the essence of education. AI technology is adopted to make up for the inherent deficiencies of traditional foreign language classrooms, build precise, humanized and efficient new classroom models, comprehensively improve the quality of college English education, promote in-depth reform of foreign language teaching, and cultivate compound foreign language talents with cross-cultural communication competence for the digital era [1].

4. Innovative Paths of College English Flipped Classroom Supported by AI Technology

Based on the three-stage complete teaching process and combined with the technical advantages and construction objectives of AI-enabled smart teaching, this paper proposes innovative paths for AI-supported college English flipped classrooms from four dimensions: classroom teaching design, independent learning guidance, human-machine collaborative teaching, and digital supporting mechanism construction.

4.1. Hierarchical Teaching Design Based on Learning Data to Realize Localized Adaptation of Three-stage Teaching

College English teaching in China is dominated by large-class teaching, with significant differences in students' language proficiency, listening and speaking abilities, and independent learning habits. Traditional flipped classrooms generally copy foreign small-class teaching modes, with unified pre-class resources, generalized in-class discussions and homogeneous after-class exercises, leading to loose connection of the three teaching stages and formalized reform. AI teaching platforms can effectively solve these problems. In the pre-class stage, teachers collect learning data through basic tasks such as vocabulary tests, oral repetition and reading exercises. The system generates authentic learning portraits, divides students into ability levels, and pushes differentiated preview content in accordance with the teaching syllabus, eliminating the "one-size-fits-all" preview mode. In the in-class stage, teachers explain common

difficulties counted by the platform and carry out hierarchical group inquiry based on individual weaknesses, ensuring classroom activities focus on students' real learning problems rather than formal procedures. In the after-class stage, the platform pushes targeted consolidation and extended tasks based on students' full-process learning performance to help them make up for deficiencies and improve language competence. AI connects the complete pre-class, in-class and after-class teaching chain to form a data-driven closed-loop teaching model, optimize flipped classroom structures based on local learning conditions, and solve the localization adaptation problem of imported teaching modes.

4.2. Construction of Intelligent Independent Learning System to Alleviate Learning Deficiencies and Academic Differentiation

Independent learning is the core premise of flipped classrooms, but most college students lack independent planning and self-discipline abilities due to long-term passive learning [15]. Common problems including perfunctory preview, overlapping academic pressure and low learning enthusiasm, together with the polarization of excellent student dominance and underachiever marginalization in classroom discussions, lead to uneven learning outcomes. To address these problems, an all-weather adaptive intelligent learning platform is built to support students' whole-process learning. Before class, the platform pushes preview reminders and quizzes on schedule, records learning progress and completion quality, and pushes basic review materials for underachievers to ensure effective pre-class learning while controlling task volume to avoid excessive burden. In class, the platform adopts intelligent balanced grouping and hierarchical learning materials, and provides virtual oral training functions to enable repeated imitation and practice for underachievers and high-level critical thinking expansion for top students, balancing overall classroom participation [12]. After class, the intelligent Q&A system answers students' questions on grammar, vocabulary and sentence patterns at any time to support independent knowledge consolidation. The full-process intelligent learning support effectively improves students' independent learning abilities and narrows the English proficiency gap among students.

4.3. Construction of Human-machine Collaborative Teaching Model to Reduce Teacher Workload and Improve Digital Teaching Competence

The complete three-stage flipped classroom puts forward higher requirements for teachers' lesson preparation, tutoring and evaluation work. Repetitive work such as pre-class resource development, in-class classroom management and after-class correction and statistics greatly increases teachers' work pressure and causes job burnout [8]. Meanwhile, most teachers lack systematic digital teaching training and experience, making it difficult to design high-quality flipped classroom teaching schemes. Human-machine collaborative teaching enabled by AI can effectively relieve teachers' work pressure and make up for their digital teaching deficiencies [14]. Before class, intelligent lesson preparation tools rapidly generate courseware, listening materials, hierarchical exercises and micro-lessons through automatic editing, subtitle production and material integration, greatly reducing the difficulty of resource development. In class, AI collects real-time classroom interaction data and sorts out common learning problems, providing references for teachers' Q&A and classroom organization and reducing classroom management pressure. After class, the intelligent correction system completes objective question scoring and composition error correction, and automatically generates error analysis reports, reducing teachers' mechanical correction work. In addition, the platform provides abundant flipped classroom cases and digital teaching training resources to help teachers update teaching concepts and improve digital teaching design abilities. This enables teachers to focus more on core educational links such as classroom interaction and thinking guidance, and take the initiative to participate in teaching reform.

4.4. Improvement of Intelligent Resource and Multiple Evaluation Systems to Consolidate the Long-term Operation Foundation of Flipped Classrooms

Slow resource updating, insufficient school-based materials, limited inter-school sharing and single evaluation methods are key factors restricting the normalized development of college English flipped classrooms. Many colleges only focus on pre-class video learning and in-class discussions while ignoring after-class extension and process assessment, resulting in broken three-stage teaching procedures and unsustainable reform. The AI-enabled digital guarantee system optimizes supporting mechanisms from the dimensions of resources, evaluation and management. In terms of resource construction, the intelligent platform integrates high-quality micro-lessons, listening and reading materials and classroom activity schemes from various schools, and updates resources dynamically according to teaching progress, breaking inter-school sharing barriers and avoiding repeated resource development [16]. In terms of teaching evaluation, the single final written examination assessment is replaced by a full-process evaluation system that collects data of pre-class preview, classroom interaction, group collaboration, after-class expansion and phased tests. The dual evaluation system of "process assessment + summative assessment" emphasizes the evaluation of students' language application ability and weakens exam-oriented assessment tendencies [3]. In addition, the lightweight cloud platform adapts to the hardware conditions of ordinary campuses. System-generated learning situation reports and teaching ledgers provide data support for school teaching research management and teacher incentive systems, forming a long-term guarantee system integrating resources, evaluation and management mechanisms, and promoting the high-quality and normalized implementation of college English flipped classrooms.

Against the background of comprehensive educational digitalization, AI technology provides a feasible innovative path to solve the localized implementation dilemmas of college English flipped classrooms. Traditional flipped classrooms are restricted by inadequate localization adaptation, learning differentiation, excessive teacher workload and single evaluation systems. In contrast, the AI-enabled closed-loop teaching system covering pre-class, in-class and after-class stages realizes the localized reconstruction of teaching modes through hierarchical teaching design, intelligent learning assistance, human-machine collaboration and digital guarantee mechanisms, and promotes the coordinated development of students' language

ability and teachers' digital literacy. Technology always serves the essence of education. College English teaching should rationally apply AI tools, balance the instrumental value of technology and the core objectives of foreign language education, continuously improve supporting resources, evaluation and management systems, promote the normalized and high-quality development of flipped classrooms, cultivate compound talents with proficient language application ability and cross-cultural literacy, and facilitate the in-depth digital reform of higher foreign language education.

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