Design of an AI-based Personalized English Self-learning System

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Abstract: With the rapid development of artificial intelligence (AI) technology, its application in the field of education has become crucial for enhancing teaching quality and learning efficiency. This study aims to explore the design theory and methods of a personalized English self-learning system based on AI. The research first analyzes the current issues in English learning, such as the uneven distribution of learning resources, the monotony of the learning process, and the unpredictability of learning outcomes. On this basis, the study proposes a design framework for a personalized learning system that integrates AI technology, including three core modules: intelligent recommendation of learning resources, dynamic monitoring of the learning process, and intelligent assessment of learning outcomes. Through theoretical analysis and literature review, this study elaborates on the design principles and implementation methods of each module, emphasizing the potential of AI technology in personalized learning. During the research process, a theoretical model was constructed using system analysis and design methods, combined with theories from educational psychology and cognitive science, to guide the design of the personalized learning system. The research conclusions indicate that an AI-enabled personalized English self-learning system can effectively enhance learners' motivation and learning efficiency, achieving optimal allocation of learning resources and personalized customization of the learning process. This study provides a new theoretical perspective for English education and offers a reference for the design of personalized learning systems in other disciplines.

Keywords: Artificial Intelligence; Personalized Learning; English Education; Learning System Design; Educational

Technology

1. Introduction

1.1 Research Background and Significance

In the context of globalization, the importance of English as the primary language for international communication is increasingly evident. However, traditional English teaching methods often fail to meet the personalized needs of diverse learners, leading to disparities in learning efficiency and outcomes. With the rapid advancement of information technology, artificial intelligence (AI) has revolutionized the educational sector. AI technologies can analyze learners' habits, preferences, and abilities, offering tailored learning resources and pathways that significantly enhance personalization and efficiency. Therefore, researching AI-based personalized English autonomous learning systems is of paramount practical significance and profound impact for modernizing English education and improving learners' experiences and outcomes.

1.2 Review of Domestic and International Research Status

Under the guidance of the current spirit of the two sessions, innovation and development in education, particularly the application of AI in education, have become focal points of societal interest. The design of AI-based personalized English autonomous learning systems is a critical research direction in this trend.

Domestically, Qiu Fanfan (2023) discussed the construction of an AI-based online autonomous learning system, emphasizing the role of AI in enhancing learning efficiency and personalized experiences. Wen Ximeng (2022) explored AI-based autonomous learning models for vocational English, proposing strategies for AI application in English teaching. Additionally, Liu Yan et al. (2021) provided theoretical and practical references for personalized learning system design through their scheme for performance mining

and personalized analysis based on computer-based testing and evaluation systems. Internationally, significant progress has also been made, such as the study by Song Guangdi et al. (2024) on enhancing college students' autonomous learning abilities with generative AI tools, demonstrating the potential of AI in promoting student autonomy. Current research trends indicate a deepening application of AI in education, particularly in personalized and autonomous learning, focusing on both technological innovation and enhancing educational quality and learning efficiency to meet diverse learner needs. [1-10]

1.3 Research Objectives and Content
This study aims to design an AI-based personalized English autonomous learning system that analyzes learners' individual needs and utilizes AI to provide customized learning resources and pathways. The research includes: (1) analyzing current issues in English learning; (2) exploring the application of AI in education; (3) constructing a theoretical framework for the personalized English autonomous learning system; (4) detailing the design principles and functional modules; (5) proposing a technical roadmap and evaluation methods for system implementation.

2. Application of Artificial Intelligence in Education

2.1 Overview of Artificial Intelligence Technologies
AI technologies, including machine learning, deep learning, and natural language processing, have demonstrated robust capabilities across various fields. In education, AI can be used for intelligent content recommendation, dynamic monitoring of the learning process, and intelligent assessment of learning outcomes. These applications enable more precise matching of educational resources with learner needs, enhancing learning efficiency.

2.2 AI in Personalized Learning
Personalized learning emphasizes tailored resources and pathways based on each learner's characteristics and needs. AI, by analyzing historical data and real-time feedback, can dynamically adjust content and difficulty, ensuring a challenging yet achievable learning process. For instance, machine learning algorithms can predict a learner's mastery of a topic and recommend appropriate materials accordingly.

3. Theoretical Framework for Personalized English Autonomous Learning System Design

3.1 Learning Theory Foundations
The design of a personalized English autonomous learning system should be grounded in robust learning theories. Cognitive learning theory posits that learning is an active, constructive process, with learners constructing knowledge through interaction with their environment. Thus, the system should support active exploration and knowledge construction. Additionally, sociocultural theory emphasizes the role of social interaction in learning, necessitating social features that support learner interaction and collaboration.

3.2 System Design Principles
The system should adhere to the following principles: (1) user-centricity: fully considering learner needs and preferences for a personalized experience; (2) data-driven: utilizing big data and AI to analyze learner behavior and feedback, dynamically adjusting content and strategies; (3) scalability: designing a modular structure for future expansion and upgrades.

3.3 System Functional Modules
The system includes: (1) user analysis module: collecting and analyzing learner information, history, and behavior data for personalized recommendations; (2) content recommendation module: intelligently recommending suitable resources based on user analysis; (3) learning monitoring module: real-time monitoring of the learning process, recording progress and performance; (4) effect evaluation module: assessing learning outcomes through tests and feedback, guiding subsequent learning.

4. Design Methods for Personalized English Autonomous Learning System

4.1 Intelligent Recommendation Mechanism for Learning Resources
The core function of the system is the intelligent recommendation of learning

resources based on learners' personalized needs and progress. This mechanism typically employs collaborative filtering, content-based filtering, or hybrid recommendation algorithms. For instance, collaborative filtering analyzes the learning histories of similar users to recommend resources, while content-based filtering matches resource content with user preferences. To enhance accuracy, the system should integrate multiple algorithms and continuously optimize the recommendation model using machine learning. Additionally, the mechanism should consider the diversity of learning resources to avoid "information cocoons."

4.2 Dynamic Monitoring Methods for the Learning Process

Dynamic monitoring is crucial for ensuring learning effectiveness. The system should collect real-time learner behavior data, such as learning time, paths, and interactive feedback, and analyze these using data mining techniques like sequence pattern mining and anomaly detection to identify learning patterns and potential issues. For example, by analyzing learning paths, the system can identify where learners struggle and adjust strategies accordingly. The monitoring system should also have an alert function to provide timely assistance when learner status anomalies occur.

4.3 Intelligent Assessment Techniques for Learning Outcomes

Assessment of learning outcomes is a critical indicator of system effectiveness. Intelligent assessment techniques should comprehensively and objectively evaluate learner achievements, involving automated scoring systems, learning analytics, and feedback mechanisms. Automated scoring systems can assess writing and speaking using natural language processing. Learning analytics deepens data insights to provide comprehensive learner evaluations. Feedback mechanisms should offer personalized feedback and suggestions based on assessment results, helping learners understand their progress and guide subsequent learning.

5. Technical Roadmap for System Implementation

5.1 Technology Selection and Architecture Design

The system should adopt a mature and scalable technology stack. For instance, front-end development could utilize frameworks like React or Vue.js, while the back-end might choose Node.js or Python Django. For databases, NoSQL solutions such as MongoDB, suitable for handling large datasets, should be considered. Architecturally, the system should adopt a microservices approach to enhance flexibility and maintainability, with each functional module (e.g., user analysis, content recommendation, learning monitoring) designed as a standalone service communicating via APIs.

5.2 System Development Environment and Tools

The development environment should prioritize efficiency and team collaboration. Integrated development environments (IDEs) like Visual Studio Code or IntelliJ IDEA can boost coding productivity. Version control systems such as Git should be employed for code management. Additionally, continuous integration/continuous deployment (CI/CD) tools like Jenkins or GitLab CI can automate testing and deployment processes, ensuring software quality.

5.3 System Testing and Evaluation Methods

System testing should encompass functional, performance, and security testing. Functional testing ensures each module operates as intended, performance testing assesses system behavior under high load, and security testing identifies potential vulnerabilities. Evaluation methods should include both quantitative and qualitative analyses. Quantitative analysis can be conducted through user satisfaction surveys and comparative studies of learning outcomes. Qualitative analysis involves user interviews and case studies to gain deeper insights into user experiences and system effectiveness.

6. Discussion

6.1 Innovations in System Design

The innovation of this system lies in the deep integration of AI technologies into autonomous English learning, achieving intelligent resource recommendation, dynamic process monitoring, and smart assessment of learning outcomes.

The integration of these features not only enhances personalization and efficiency but also introduces a new pedagogical model for English education.

6.2 Potential Challenges in System Application

Despite its innovative design, the system faces challenges in practical application. For example, data privacy and security must comply with relevant laws and regulations. Additionally, the adoption and acceptance of the system are influenced by the perceptions of educational institutions and learners. Therefore, the design and promotion of the system must consider these factors comprehensively.

6.3 Future Research Directions

Future research could focus on: (1) further optimizing recommendation algorithms to enhance accuracy and personalization; (2) developing more learning analytics tools to deepen understanding of the learning process; (3) exploring the application of AI technologies in other subject areas to expand the system's applicability.

7. Conclusion

7.1 Summary of Research Findings

This study successfully designed an AI-based personalized English autonomous learning system, which effectively enhances the personalization and efficiency of English learning through features like intelligent recommendation, dynamic monitoring, and smart assessment.

7.2 Contributions and Significance of the Research

The contribution of this research lies in providing a new pedagogical model for English education, addressing issues in traditional teaching through technological means, and improving learners' experiences and outcomes.

7.3 Research Limitations and Prospects

While this research has achieved certain results, limitations remain, such as the need for further validation of the system's practical application effects. Future research could continue to optimize system functions, expand experimental scales, and explore more application scenarios.

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