



Application Practice and Innovative Exploration of AIED Technology in the Education of Rural Left-behind Children

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Abstract

This study focuses on the application practice and innovative exploration of Artificial Intelligence in Education (AIED) in promoting the education of rural left-behind children. By comprehensively utilizing methods such as literature review and field case analysis, and through in-depth mining and visual presentation of core literature in the field of AIED over the past five years, the study aims to reveal its positive roles in balanced allocation of educational resources, improvement of teaching quality, and innovation of learning modes. The research findings indicate that AIED technology effectively alleviates the shortage of educational resources faced by rural left-behind children, and significantly narrows the urban-rural education gap, by integrating high-quality educational resources from across the country and even globally, building personalized learning platforms, and implementing a dual-teacher teaching mode of "online master teacher + offline tutoring". In terms of enhancing learning outcomes, AIED technology not only improves students' academic performance but also strengthens the mental health of left-behind children through intelligent mental health monitoring and intervention.

1. Introduction

This study explores the challenges and innovative applications of Artificial Intelligence in Education (AIED) technology, particularly focusing on its use in addressing educational inequalities faced by rural left-behind children. The purpose of the study is to examine how AIED technologies can overcome barriers such as limited infrastructure, data security concerns, and resistance to changes in educational paradigms. The research highlights the potential for AIED to enhance the quality and accessibility of education in rural settings through targeted strategies and frameworks.

1.1 Literature Review

Artificial Intelligence in Education (AIED) technology, a product of the integration between education and cutting-edge artificial intelligence, represents a pivotal shift in transforming educational models towards greater intelligence and personalization (Chen, 2022). This technology encompasses a broad range of key areas, including machine learning, expert systems, chatbots, and virtual simulation systems, all working together to create a comprehensive and effective learning environment. These core dimensions enable the construction of a personalized educational system capable of meeting the unique needs of individual students (Zhang & Li, 2021).

AIED technology relies primarily on machine learning, which provides the algorithmic foundation for personalizing education. By analyzing extensive learning data, machine learning allows for the creation of customized learning paths and teaching plans tailored to students' learning habits, ability levels, and interests. This results in more relevant and effective learning experiences (Huang, 2023).

The integration of expert systems and chatbots further enhances the interactivity and guidance of the system. Expert systems simulate human decision-making to offer professional and authoritative learning advice, while chatbots serve as continuous learning partners, assisting students at any time with real-time feedback (Yu & Wang, 2022). This interaction fosters an immersive, interactive, and personalized learning experience.

Moreover, visual virtual environments and virtual simulation systems enable immersive learning scenarios, enhancing students' understanding and memory by simulating both real and fictional environments. These systems deepen engagement and improve knowledge retention (Chen, 2022).

The combination of these technologies, including intelligent feedback systems and learning management systems, optimizes educational processes and student outcomes. The feedback system monitors students' learning progress and effectiveness, providing real-time adjustments and suggestions, while the learning management system integrates resources and optimizes the teaching process, ensuring smooth management of educational activities (Zhang & Li, 2021).

Together, these technologies create a highly efficient, interactive, and personalized learning environment, revolutionizing education by enhancing learning outcomes and supporting the intelligent transformation of educational systems (Huang, 2023).

1.2 Value of AIED Technology

AIED technology offers significant contributions to improving the educational experience and promoting equity in learning across geographic regions:

Improving Teaching Quality

AIED technology enhances teaching quality by providing detailed feedback through big data analysis of students' learning behaviors and outcomes. This enables educators to adjust their teaching strategies quickly, ensuring the content aligns with student needs and ultimately improving teaching efficiency (Huang, 2023).

Intelligent Optimization of Learning Resource Allocation

AIED optimizes the allocation of learning resources by matching students with the most suitable resources based on their learning profiles and interests. This personalized approach allows students to master key knowledge and skills more efficiently (Yu & Wang, 2022).

Promoting Educational Equity Across Geographic Regions

AIED technology eliminates geographic barriers to education by making high-quality resources accessible in remote and underserved areas. This promotes a more equitable distribution of educational opportunities, ensuring that marginalized groups, such as rural left-behind children, have access to the same educational standards as their urban counterparts (Chen, 2022).

Through these capabilities, AIED technology not only enhances the quality of education but also fosters a fairer and more inclusive educational landscape (Zhang & Li, 2021).

Table 1. Example of Table

AIED system	specific application	origins
Machine learning	Analyzing Learner Data: 2017 Predictive and Adaptive Interventions	Yu, M. H., Feng, X. et al. 2017 Predictive and adaptive interventions Wei Y, Yang Q, et al, 2018
Personalized learning systems/ environments	Provide resources for customized learning; Recommending personalized learning paths	Bhutoria Aditi, 2022 Samarakou M, Tsaganou G, et al, 2018
Expert system	Developing instructional planning: improving the quality of learning interactions: optimizing instructional management systems	LI Qiang, 2020 Hwang G, Sung H, et al, 2020 Dias B, Hadjileontiadou S J, et al, 2015
Intelligent tutors	Recommends learning materials; guides the learning process according to learner needs and preferences; provides feedback on the status of learning	Wang Xianfu, Mao Meijuan, Yan Hanbing, 2019 Mclaren B M, Deleeuw K E, et al, 2011 Köse U, Arslan A, 2016
Chatbots	Interactive learning; increased interest and participation in learning	Wang Haochang, Li Bin, 2018 Fryer L K, Ainley M, et al, 2017
Visualization and Virtual learning environment	Increase learning engagement and collaboration; visualize information to improve ontological feedback; deepen the learning experience	Leony D, Muioz-Merino P J, et al, 2013 Griol D, Molina J M, et al, 2014
Virtual simulation system	Conduct hands-on VR training; hone motor control skills; deepen immersive learning experience	Zhang Ze, Lu Xin, 2021 Shorey S, Ng E D, 2021
Intelligent feedback system	Customized testing; remote checking; evaluation of subjective and technical answers	LiH, Wang H, 2020 Cutumisu M, Chin D B, et al, 2019
Learning management system	Managing the learning process; optimizing communication and collaboration; allocating teaching resources	Hill Ann, 2020 Collaboration: allocation of teaching resources Popenici S, Kerr S, 2017

2. Research Methods

Basic situation and characteristics

(1) Huge scale and slow growth trend

According to the authoritative data released by the All-China Women's Federation, the total number of left-behind children in rural areas in China has exceeded 61 million, and the number is growing slowly but steadily. This large group is widely distributed throughout the country, especially in the central and western labor exporting provinces, as well as Jiangsu, Guangdong and other economically developed provinces in the east, which also account for a non-negligible proportion of the total number of left-behind children. This situation highlights the nationwide and universal nature of the problem of rural left-behind children, which needs to attract the attention of all sectors of society.

(2) Significant increase in the number of preschool-age children

In recent years, the number of preschool-age children left behind in rural areas has shown an obvious upward trend, and their proportion in the total number of left-behind children has increased year by year. This change shows that the problem of left-behind children in rural areas is no longer confined to the compulsory education stage, but penetrates earlier into the early stage of children's basic education. This not only poses a serious challenge to the all-round development of individual children, but also raises higher requirements for education equity and child welfare in the whole society.

(3) Uneven geographical distribution and significant localized concentration

The geographical distribution of left-behind children in rural areas is characterized by significant dispersion and local concentration. They are mainly concentrated in the labor exporting provinces in the central and western regions, where the relatively low level of economic development and the relative lack of educational resources have made the problem of left-behind children's education particularly prominent. This uneven geographical distribution further aggravates the complexity and urgency of the problem of education for left-behind children in rural areas, and it has become a focal point of society waiting to be solved.

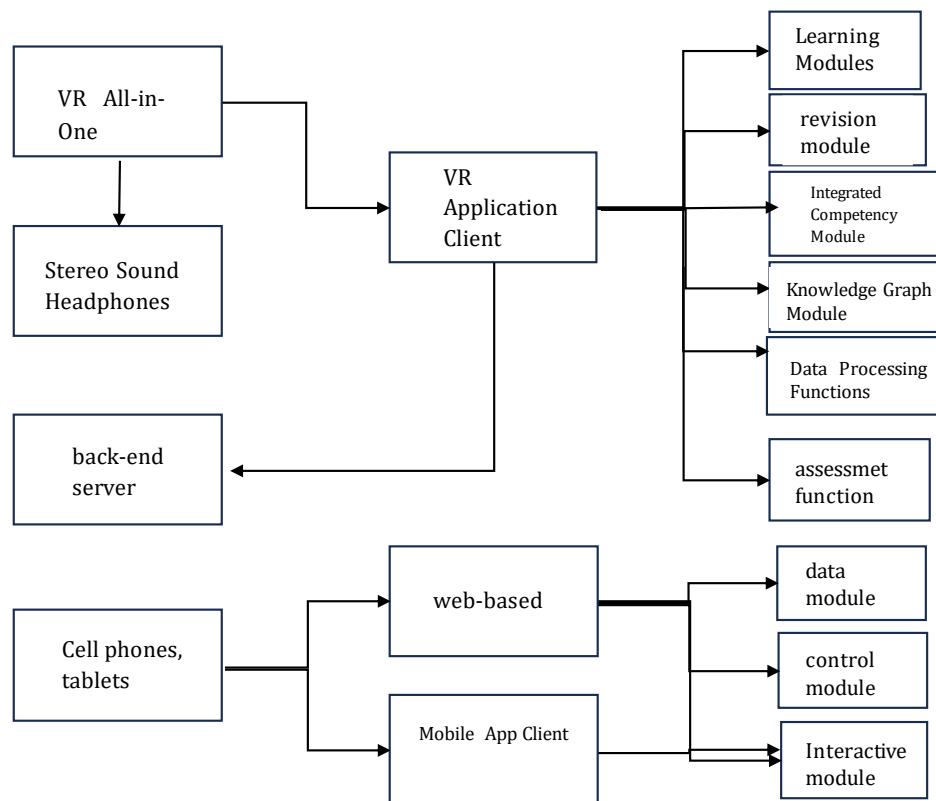


Fig. 2 Chart

Rural left-behind children are mainly raised by their grandparents or other relatives, and these guardians generally have a low level of education, which makes it difficult for them to give effective counseling and supervision in their studies. In addition, the lack of effective communication and interaction between parents and children is further aggravated by the fact that parents go out to work for long periods of time, which further exacerbates the lack of family education. This gap in family education not only affects the academic performance of left-behind children, but may also have a far-reaching impact on their mental health and personality development.

Rural primary and secondary schools face multiple challenges in the education and management of left-behind children. On the one hand, teachers are weak and teaching facilities are backward, making it difficult to provide left-behind children with sufficient educational resources and personalized educational support. On the other hand, the poor communication mechanism between schools and families makes it difficult for schools to understand the learning and living conditions of left-behind children in a timely manner, so that they are unable to take effective educational intervention measures. These problems jointly restrict the effectiveness of schools' education and management of left-behind children.

Although the government has introduced a series of policies and measures to support the education of left-behind children in rural areas, there are still problems such as insufficient efforts and limited coverage in the actual implementation process. Especially in the allocation of educational resources, the construction of teachers and other key links, the government needs to increase investment and reform efforts to ensure that left-behind children can enjoy fair, high-quality educational resources.

Although the attention and support for rural left-behind children from all walks of life has gradually increased, it is still insufficient on the whole. Although public welfare organizations and volunteers have filled the care gaps to a certain extent, their power is limited, and it is difficult to fully cover and meet the educational needs of the majority of left-behind children. Therefore, building a comprehensive social care system and mobilizing more social forces to participate in the education of left-behind children has become an urgent problem to be solved.

3. Result and Discussion

Although AIED technology has shown great potential for application in the field of education, its popularization and application still face significant difficulties. Especially in rural areas, due to the economic conditions and weak technical infrastructure, the popularization and application of AIED technology has encountered many obstacles. These barriers not only hinder the widespread application of AIED technology in rural areas, but also limit the opportunities for rural left-behind children to receive high-quality educational resources.

The implementation of AIED technology relies on the collection and analysis of student learning data and behavioral data. However, the issues of data security and privacy protection become particularly prominent in this process. Especially in rural areas, the security of students' personal information faces greater risks due to the relative lag in cybersecurity awareness and technological level. How to ensure the effective protection of students' data security and privacy in the process of data collection, storage and analysis has become an urgent problem.

The application of AIED technology requires a corresponding transformation of educational philosophy and teaching mode. However, in rural areas, the deep-rootedness of traditional education concepts and teaching modes makes this transformation process face greater resistance. To promote the widespread application of AIED technology in rural areas, it is necessary for the government, schools, parents and all sectors of society to work together to promote the updating of educational concepts and the innovation of teaching modes in order to adapt to the needs of the development of new technologies.

In order to cope with the problems of technology popularization and application difficulties, efforts should be made to strengthen the R&D and promotion of AIED technology. Specifically, this can be achieved through the following measures: first, increase R&D investment and optimize technical solutions to improve the practicality and adaptability of the technology; second, reduce the application cost, and make the AIED technology more affordable through large-scale production and technical optimization to facilitate the promotion of AIED technology in rural areas; third, carry out a wide range of publicity and training activities to enhance the awareness and acceptance of AIED technology among rural educators and students, so as to promote the popularization and application of AIED technology in the countryside. Third, carry out extensive publicity and training activities to enhance the awareness and acceptance of AIED technology among educators and students in rural areas, so as to promote its wide application in rural areas.

A comprehensive data security protection system must be constructed to address the issues of data security and privacy protection. This includes strengthening network security protection and adopting advanced encryption technology and firewalls to ensure the security of data transmission and storage; at the same time, establishing a perfect data management system, clarifying the processes and responsibilities of data collection, storage, use and destruction, and preventing data leakage and misuse; in addition, it should also strengthen publicity and education on data security for students, enhance their self-protection awareness, and jointly safeguard data safety and privacy protection. and privacy protection.

To address the issue of the transformation of educational concepts and modes, the innovation of educational concepts and modes should be actively promoted. This includes the introduction of new educational concepts and methods, such as student-centered teaching concepts, project-based learning, etc., to stimulate students' initiative and creativity; at the same time, teacher training and learning exchanges should be strengthened to enhance teachers' professionalism and teaching ability, so that they can better adapt to the changes in teaching and learning brought about by the new technology; moreover, the actual situation and students' needs in rural areas should be taken into account, so that the application of AIED technology can be explored to suit the education of rural children who stay behind. In addition, AIED technology application modes and programs suitable for rural left-behind children's education should be explored in light of the actual situation and students' needs in rural areas, so as to achieve the optimal allocation of educational resources and improve teaching quality.

4. Conclusions

In this section, the author presents brief conclusions from the results of research with suggestions for advanced researchers or general readers. A conclusion may review the main points of the paper, do not replicate the abstract as the conclusion.

Writing an academic article is a challenging but very fulfilling endeavor. Hopefully, the guidelines presented here will enable you to write your first academic article with relative ease. Students, however, often underestimate the time required to produce a “polished” first effort. You cannot write a proper research article in a weekend or even a week. It is, therefore, extremely important to allow yourself enough time –at least three to four weeks—to work on the successive draft.

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