# The Impact and Challenges of Artificial Intelligence on the Quality of Rural Compulsory Education Teaching

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**Abstract.** In today's digital age, the application of artificial intelligence in education has gradually attracted widespread attention, which is of great significance, especially in improving the teaching quality of rural compulsory education. However, rural education still lags in the exploration and utilization of AI in education, facing many realistic plights. This essay analyzes the current application status of AI in rural compulsory education, exploring its practical paths, obstacles, and equity challenges in promoting teaching quality. It points out that AI could optimize rural compulsory education through digital resource sharing, classroom teaching mode transformation, and personalized learning feedback. But it is also confronted with problems such as poor compatibility of digital resources, insufficient adaptability of the teacher-student role, and incomplete personalized learning guarantee mechanisms. Based on this, this article proposes suggestions including strengthening the construction of digital infrastructure, enhancing the compatibility of AI education resources, developing the digital literacy of rural teachers and students, as well as improving AI monitoring and evaluation systems. Thereby, these could facilitate the high-quality development of rural compulsory education and contribute to the realization of educational equity.

**Keywords:** Artificial intelligence; rural compulsory education; teaching quality; educational equity.

## 1. Introduction

With the rapid development of information technology, the application of artificial intelligence (AI) in the field of education has gradually improved the quality of education and promoted educational equity. Especially in the compulsory education stage, AI could not only provide innovative teaching solutions in intelligent evaluation and classroom interaction, but also optimize the allocation of urban and rural education resources through automation and data-driven methods, bridging the gap between urban and rural education. However, in the context of the times, there is still an imbalance in the development of urban and rural education. Due to the relative scarcity of educational resources and weak infrastructure in rural areas, the teaching quality in rural areas is still confronted with significant challenges. Therefore, studying the impact and challenges of AI on the teaching quality of rural compulsory education has become a vital issue in educational practice. This not only contributes to understanding how AI could play a role in rural education, but also provides a new perspective for promoting urban-rural education equity, which has crucial practical significance for promoting high-quality development of rural education.

In recent years, the digital transformation of education and the advancement of AI have brought new opportunities for the development of rural education. Guo and Hua pointed out that empowering education service supply through digital technology could improve the problem of uneven distribution of educational resources between urban and rural areas to some extent, and promote fairness in the starting point and process of education. Ni discussed the role of AI in promoting education equity from the perspective of "great intelligence moving to the cloud" technology [1]. She proposed to use special electronic equipment and cloud Internet technology to achieve classroom data feedback and personalized teaching, then enhancing the quality of rural teaching. Yet, the digital transformation of rural education to promote educational equity also faces many challenges, such as the urgent need to address the imbalanced allocation of digital education resources, and the obvious differentiation of intelligent technology perception sensitivity among urban and rural teachers [2]. Yao and Lei emphasized that although AI provides technical support for the revitalization of rural

education, there are limitations in terms of the essence of education and cultural inheritance, and the integration and symbiosis of rural education and artificial intelligence still need to be improved [3]. From an international perspective, Holstein and Doroudi explored the role of educational artificial intelligence (AIEd) systems in promoting educational equity, pointing out that while AIEd systems have the potential to promote educational equity, they may also amplify existing inequalities [4]. These studies collectively indicate that the digital transformation of education and the application of AI have great potential in improving the quality of rural compulsory education teaching. However, systematic exploration is also needed in areas such as technology application, resource allocation, teacher development, and cultural inheritance to achieve balanced development of urban and rural education.

This essay focuses on the impact and challenges of AI on the quality of rural compulsory education teaching and aims to systematically explore the optimization path of AI in rural education resource sharing, classroom teaching reform, and teaching effectiveness feedback, revealing the obstacles and equity challenges it faces, and proposes targeted solutions. Through in-depth analysis of the current application status and problems of AI in rural compulsory education, it could not only provide theoretical support for the digital transformation of rural education, but also provide useful references for education policymakers and practitioners. It promotes the high-quality development of rural compulsory education and facilitates achieving educational equity.

## 2. Practical Paths of AI Assisting in Improving the Teaching Quality of Rural Compulsory Education

### 2.1. Sharing of Rural Education Resources and Teacher Workforce Empowered by AI

In rural areas, due to realistic issues such as funding shortages and geographical isolation, compulsory education in rural areas has been limited in teaching preparation to a certain extent. Under this context, the intelligent application of AI could adjust and optimize the resource allocation of rural compulsory education in diverse ways, sharing high-quality teaching resources between urban and rural areas. Thus, it has greatly promoted the teaching quality of rural compulsory education.

In terms of expanding access to rural education resources, AI connects superior education resources from external urban areas with rural resources through online learning platforms and intelligent tutoring systems. For example, when rural students need to learn standard spoken English, they can watch high-quality oral teaching videos of famous teachers through online learning platforms. Intelligent robots or related apps could also collect and analyze data on rural students' pronunciation, grammar, and intonation to recommend suitable ways for different learners [5]. Therefore, AI intelligent platforms provide tailored online courses, virtual laboratories, and interactive intelligent tutoring services for rural students, which breaks through spatial limitations to some extent and effectively alleviates the imbalance of teaching resources between urban and rural areas [6]. It is crucial for narrowing the education gap between urban and rural education.

For sharing teacher workforce, especially in the fields of natural sciences and social sciences beyond basic disciplines, AI also serves as an important bridge. By AI cloud platforms, urban and rural teachers could collectively prepare lessons, share teaching resources, and even engage in timely interaction. These platforms promote educational collaboration and experience sharing between urban and rural teachers, providing unprecedented support for rural compulsory education [4].

### 2.2. Transformation of Rural Classroom Teaching and Reshaping of Teacher-Student Interaction under the Intervention of AI

#### 2.2.1. AI promotes innovation and upgrading of rural teaching models

In the teaching process, the introduction and application of AI provide students with personalized learning experiences because the traditional teaching mode in rural areas is often difficult to match every student's learning ability. Elifas and Simuja pointed out that by using AI tools such as Geogebra

and Khan Academy, rural students could engage in personalized learning based on their own pace and ability level, obtaining customized exercises [7]. This personalized teaching model focuses more specifically on the learning situation of rural students, while avoiding the traditional classroom teaching model of "one size fits all".

AI not only serves as an auxiliary tool for transforming teaching models, but also guides innovation in classroom teaching methods. For instance, in mathematics teaching, especially abstract content such as geometry and algebra, AI could help students establish a deeper understanding of mathematical concepts through dynamic visualization and interactive learning platforms [7]. The use of AI has transformed the teaching mode from traditional lecture type to an exploratory and interactive type, enabling rural education to achieve more humane and high-quality teaching in limited resource situations.

#### 2.2.2. AI facilitates the transformation of the interactive relationship between rural teachers and students

AI has made the teaching method of rural compulsory education more student-centered, and teachers are no longer simply knowledge transmitters in the classroom, but have become guides and supporters. AI assists teachers in customizing learning content based on students' learning needs, allowing students to engage in deeper collaboration and discussion with teachers and peers during the learning process [8]. This transformation lets the teacher-student relationship no longer be limited to traditional statics, but be more dynamic and interactive. This interactivity is not restricted to immediate feedback in the classroom, but also includes self-directed learning and online discussions after class. AI provides students with more flexible learning methods, allowing them to communicate in a wider learning space. This interactive approach deepens the emotional connection between rural teachers and students and enhances their understanding [9]. Especially in the limited environment of rural education resources, the support of AI could compensate for the insufficient communication and feedback between teachers and students, thereby enhancing the effectiveness of teaching and improving the quality of teaching [9].

### 2.3. Effective Feedback of Rural Teaching Based on AI Monitoring and Evaluation Mechanism

#### 2.3.1. AI monitors and evaluates students' personalized dynamic learning performance of rural students

The personalized monitoring and evaluation function of AI in rural education could capture students' learning status timely and dynamic manner and adjust according to their learning characteristics to achieve precise teaching. With the assistance of AI, teachers could monitor students' learning data in real time and evaluate their academic performance to achieve the goal of timely discovering students' weaknesses.

In the application case of the MindCraft platform in rural India, AI is used to monitor and analyze students' learning trajectories and interaction data. It could evaluate students' performance in subjects such as mathematics and language and assist teachers in accurately identifying students' learning bottlenecks, thereby significantly improving the learning effectiveness and teaching efficiency of rural students [10].

#### 2.3.2. AI timely learning feedback mechanism contributes to adjusting teaching strategies

While AI dynamically monitors and evaluates students' learning situations, AI's timely feedback mechanism could strive to align teaching content with students' learning needs. This mechanism allows teachers to respond quickly based on students' learning progress, thus improving the accuracy and timeliness of teaching content. By providing timely feedback on students' learning issues through AI, teacher engagement has been increased, and the self-regulation ability of the teaching model has also been enhanced [7].

The feedback of AI technology can not only inform teachers to adjust teaching strategies promptly when students encounter learning obstacles, but also provide continuous support for teachers through

the update of learning data. For instance, the application of AI in rural areas of Ghana could help teachers identify students' weak subjects. When providing personalized learning materials, AI could also reflect students' learning attitudes and emotional reactions in real time, thus helping teachers optimize teaching plans more deeply. This efficient, timely feedback mechanism enhances the flexibility of rural teaching strategies. Meanwhile, it promotes rural students to gain higher quality personalized learning experiences [9].

## 3. Obstacles and Equity Challenges of Improving the Teaching Quality of Rural Compulsory Education in the Context of AI

However, when enhancing the quality of every aspect of the teaching process, the application of AI in rural compulsory education still faces a variety of challenges.

Firstly, the differences in support for digital teaching between urban and rural areas and the gap in compatibility of digital resources have turned into significant obstacles. Due to the relative shortage of hardware equipment and insufficient infrastructure construction, rural areas generally lack a stable power supply and high-speed Internet, which results in difficulty in using AI regularly. In rural primary schools of Namibia, hardware equipment such as computers, tablets, and smart projectors is generally not fully equipped, and teachers frequently encounter power outages and unstable networks during the teaching process, which makes the continuous use of AI relatively difficult [7]. Similarly, in rural areas of China, the network coverage and stability are far behind those in urban areas, especially in remote areas where network connection issues even seriously affect the development of online teaching. It can be seen that the significant gap in digital support between rural and urban areas greatly restricts their access to and use of online educational resources [5]. Furthermore, the adaptability of rural digital education resources should not be ignored. In the research on rural compulsory education in Namibia and China, it was found that most of the existing AI education resources are developed based on the background and needs of urban students. The examples and scenes provided by these AI tools cannot be directly connected to rural students, and they lack content that is compatible with rural actual life and cultural background. This greatly affects the effectiveness and pertinence of rural teaching [7, 9].

Then, the adaptability disparity of classroom teaching models and teacher-student roles is also a major barrier to rural compulsory education. In traditional classroom teaching, teachers usually occupy a dominant position, while students play a passive role of receiving knowledge. Nevertheless, the application of AI has transformed the role of teachers from knowledge transmitters to guides and assistants, meanwhile students have played the main roles in the learning process [5]. Because of the strong ability of urban teachers to quickly adapt to new roles, this transformation is relatively easy to achieve in urban compulsory education. Yet in rural schools, the transformation of classroom models and teacher-student roles has certain difficulties. Rural teachers generally adhere to traditional teaching thinking centered on teachers, and relatively lack the recognition and adaptability of role transformation. They lack sufficient vitality in updating teaching concepts. Simultaneously, the learning habits and cognitive styles of many rural students also rely more on the traditional teaching classroom model, lacking the willingness and ability to actively adapt to the autonomous learning methods advocated by AI [5]. In addition to a lack of awareness, rural teachers and students generally have poor digital literacy and technological adaptability, making it hard to effectively utilize AI for high-quality teaching and learning. According to Budnyk et al., rural teachers often face the risk of technological alienation when applying digital technology, which means excessive reliance on technology while ignoring the essence of teaching [8]. They are essentially unable to properly integrate tools with curriculum objectives. For rural students, their generally low digital literacy not only affects their ability to operate and use artificial intelligence learning tools, but may also lead to a lack of discernment and processing skills when facing complex digital information [5]. Additionally, the application of AI has reduced direct interaction between rural teachers and students to a certain extent, weakening teachers' emotional support for students. Fang pointed out that rural students in

Ghana have reported that AI virtual teachers, known as "smart learning companions," could not understand their dialects and provide emotional care like real teachers, which affects the learning experience of rural students [9].

With the widespread application of AI in the field of compulsory education, AI monitoring, evaluation, and feedback systems have become important means of ensuring personalized learning for students. However, obvious differences have gradually emerged in the guarantee mechanism of personalized learning between urban and rural education environments, leading to severe challenges to urban and rural equity. In urban areas, AI monitoring and evaluation technology relies on advanced technological foundations and sophisticated systems to collect personalized learning behavior data from students in real time, tracking their learning progress and automatically grading, thereby accurately identifying students' learning gaps [6]. But in rural areas, owing to incomplete data input and limitations in algorithm training, AI monitoring systems are unable to collect students' classroom participation and knowledge mastery in a comprehensive and timely manner like urban schools, which leads it difficult to effectively presenting the complete picture of personalized learning for students [8]. In terms of AI assessment capabilities, AI models trained on urban student data may not accurately reflect the learning characteristics and needs of rural students. And this algorithmic bias may lead to doubts about the reliability of personalized learning guarantees for rural students [6]. For AI feedback systems, many rural teachers find it difficult to adjust their teaching methods promptly based on feedback content, and students cannot use feedback to optimize their learning. This has failed AI feedback mechanisms to be transformed into effective personalized learning interventions. When the feedback received by students lacks systematicity and coherence, a dynamic and continuous personalized learning path cannot truly form [6]. Moreover, compared to urban areas, rural areas lack professional AI support personnel, making it tough to effectively maintain and optimize AI monitoring, evaluation, and feedback systems, further exacerbating the inequality in teaching quality between urban and rural areas [6].

## 4. Strategies for Dealing with the Difficulties of Rural Compulsory Education Assisted by AI

In the context of AI, the teaching quality of rural compulsory education is still constrained by complex and diverse practical difficulties, and educational equity is also facing severe challenges. To effectively address these challenges and improve the teaching quality of rural compulsory education, it is necessary to focus on every aspect of the teaching process and develop systematic solutions.

In response to the differences in support for digital education between urban and rural areas, the government could implement the "Digital Countryside" special plan, which aims to upgrade and transform the AI network infrastructure of rural schools. Establish a special fund to provide targeted subsidies and reduce the cost of using AI networks in rural areas [6]. On this basis, for the sake of narrowing the gap in digital resource adaptability, selecting some rural schools as pilot projects for "smart campuses" is also a desirable approach. By inviting education experts, AI developers, cultural scholars, and rural teachers to participate and conduct in-depth research of rural areas, they could realize the real learning needs, living scenarios, and cultural characteristics of rural students, thereby developing AI education resources that are closely integrated with rural reality [6]. The successful experience of pilot rural schools can gradually be extended to a wider range of rural schools, promoting the compatibility of rural teaching and the overall digitalization process of rural compulsory education.

The key to gradually eliminating the gap between urban and rural classroom teaching models and the adaptability of the teacher-student role is the transformation of consciousness and technology literacy. For rural teachers, the government should launch a specialized "AI+Education" training program and invite educational technology experts and experienced teachers to share application cases of AI teaching, accelerating the transformation and updating of their roles [5]. At the technical level, the training content should cover the operation of AI tools, the design of AI classroom teaching

modes, and how to use AI data for teaching reflection. Meanwhile, provide opportunities for practical operation for simulated teaching [5]. Furthermore, improving the exchange mechanism between urban and rural teachers could also contribute to narrowing the gap. Regularly organize urban teachers to conduct demonstration teaching and guidance in rural schools, and invite rural teachers to observe and learn in urban schools [9]. Through this bidirectional communication, experience sharing between urban and rural teachers can be promoted [9]. For rural students, the government should add more project-based learning and inquiry-based learning in the curriculum of rural schools, guiding students to actively explore knowledge with AI and improve their self-learning ability [7]. Offering information technology courses and digital literacy training aims to help rural students proficiently master and utilize digital tools for learning.

It is crucial to improve the AI monitoring, evaluation, and feedback system for rural schools in response to the urban-rural equity challenge of personalized learning guarantee mechanisms. Firstly, the training data of the AI model should be optimized. The AI technology team should collaborate with rural schools to collect more multidimensional data from rural students to improve the database and usability. Based on these diverse data inputs, AI models can more accurately reflect the learning characteristics of rural students, thereby reducing algorithm bias and improving the reliability of personalized learning guarantees [8]. Through continuous model optimization and validation, the effectiveness and adaptability of AI tools in rural education environments could be improved to a certain extent, providing more accurate learning support and feedback for rural students. On the other hand, the government and enterprises should cooperate to provide professional IT personnel and technical maintenance services for rural schools, and regularly inspect the operation of the system to promptly identify and solve problems, ensuring the stable operation and effective application of AI tools [11].

## 5. Conclusion

In summary, the application of AI in rural compulsory education is of great significance for improving teaching quality and promoting educational equity. This essay analyzes the optimization approaches of artificial intelligence in rural compulsory education, indicating its enormous potential in optimizing educational resource allocation, transforming classroom teaching models, and achieving personalized learning. AI provides innovative solutions to the problems of scarce educational resources and single educational models in rural areas, but it also faces challenges such as weak digital infrastructure, insufficient resource adaptability, and poor teacher-student role adaptability in the application process. Nevertheless, fully leveraging the advantages of AI still requires joint efforts from all parties. So this article proposes systematic response strategies, including strengthening the construction of rural digital infrastructure, developing AI education resources closely integrated with rural reality, enhancing the digital literacy of rural teachers and students, and improving AI monitoring and feedback systems. The implementation of these measures will contribute to building a more advanced rural education environment and promote the high-quality development of rural compulsory education, providing strong support for achieving balanced development of urban and rural education.

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