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The Roles of Artificial Intelligence Technology in Enhancing Remote Education for University Students in Chongqing, China

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ABSTRACT

This study investigates the roles of Artificial Intelligence (AI) in enhancing remote education for university students in Chongqing, China, focusing on the post-COVID-19 era. Employing a Systematic Literature Review (SLR), the research addresses two key questions: (RQ1) the reasons for using AI in remote education, and (RQ2) the challenges associated with its implementation. A search was conducted using Google Scholar, selected for its broad access to interdisciplinary scholarly works. Articles published between 2021 and 2024 were analyzed. The study found that AI enhances remote education by offering convenience and flexibility tailored to students' individual learning paces and needs. It enriches the learning experience through diverse and engaging course content and enables personalized learning paths with resource recommendations based on students' abilities and learning history. Key tools include virtual tutoring systems, intelligent assignment grading systems, and virtual laboratories, which collectively address educational gaps in remote settings. However, challenges persist, including technical adaptation issues, data privacy and security concerns, unreliable network connections, and a lack of interpersonal interaction. The paper concludes with improvement measures such as strengthening data security, improving infrastructure, and incorporating hybrid learning approaches.

Keywords: Artificial intelligence; remote education; learning engagement; learning satisfaction

1.   INTRODUCTION

In today's globalized era, remote education has become a crucial teaching mode. Especially during the COVID-19 pandemic, many universities shifted to remote education to ensure the continuity of teaching (Han & Trimi, 2002). During this key transition, the extensive application of AI technology significantly improved the quality and effectiveness of remote education, bringing revolutionary changes to the field of education (Chen, Chen, & Lin, 2020; Hashim et.al., 2022). With the rapid development of information technology, the application of AI technology in various fields continues to expand and deepen. The education sector, as a significant application scenario of AI technology, is undergoing profound changes. Improving teaching quality and student satisfaction through intelligent means has become a hot topic in current research (Shafique et. al., 2023; Almasri, 2024).

Remote education is an innovative teaching mode that relies on the internet and electronic devices, allowing students to participate in learning conveniently from different locations, breaking the constraints of time and space. This teaching method is highly flexible and convenient, providing students with a more free and personalized learning environment (Oliveira

et. al., 2021). Especially during the pandemic, remote education demonstrated significant advantages, providing continuous support and assurance for students' learning.

Chongqing, a dynamic and fast-developing city in China, provides a unique backdrop for studying the role of AI in enhancing remote education for university students. With its mix of urban and rural areas, the city faces significant challenges in ensuring equal access to quality education. The COVID-19 pandemic further highlighted these disparities, making the integration of AI solutions more crucial for bridging gaps in learning. As a growing tech hub, Chongqing is increasingly adopting AI technologies, making it an ideal location to explore how AI can address issues like personalized learning, accessibility, and student engagement in remote education.

2.   METHODOLOGY

This study employs a Systematic Literature Review (SLR) to examine the roles of AI in enhancing remote education for university students in Chongqing, China. Following PRISMA guidelines, the SLR involved the following steps. First, research questions were clearly defined:

Research question 1: What are the reasons for using AI in remote education for universities students in Chongqing, China?
Research Question 2: What are the challenges in using AI for remote education of university students in Chongqing, China?

Next, the search for relevant literature was conducted in Google Scholar, using keywords such as "AI in remote education," "Chongqing universities," and "post-pandemic education." Then, the articles were screened for relevance by reviewing titles and abstracts. After that, the eligible studies, published between 2020 and 2024, were reviewed to ensure they addressed the research questions. Finally, findings were synthesized to identify patterns and gaps.

Google Scholar was selected as the primary database due to its broad access to scholarly articles, conference proceedings, and reports. Its user-friendly interface and extensive indexing capabilities make it an effective tool for exploring interdisciplinary topics like AI in education. Limiting the search to post-2020 publications ensured the focus remained on recent developments, particularly following the accelerated adoption of AI technologies during the COVID-19 pandemic. This methodology enables an exploration of how AI enhances remote education in Chongqing universities.

3.   FINDINGS AND DISCUSSIONS

The next section, Findings and Discussions, will analyse these aspects, offering insights into the benefits, reasons for adoption, challenges, and areas for improvement. Based on existing literature, it is hoped to provide beneficial guidance for the further development of remote education.

3.1 Benefits of AI assisted learning platforms

Application of AI technology in education covers multiple aspects, including intelligent tutoring systems, adaptive learning platforms, and learning analytics tools. These advanced technologies aim to provide personalized learning experiences for students, customizing the most suitable learning paths and resources based on each student's unique needs and learning characteristics (Muthuprasad et. al., 2021). Through intelligent analysis and recommendations, AI technology

can precisely meet students' learning needs, improving teaching effectiveness and student satisfaction.

AI-assisted learning platforms, leveraging advanced intelligent algorithms, create personalized learning paths and resources for students. For example, well-known platforms like Coursera and edX fully utilize AI technology to deeply analyze students' learning behaviors, accurately recommending suitable courses and learning materials for them (Saqr, Al-Somali, & Sarhan, 2023). These platforms can customize the most appropriate learning plans for students based on their learning goals, interests, and knowledge levels, helping them learn and master knowledge more efficiently.

Adaptive learning systems can dynamically and flexibly adjust teaching content and difficulty based on students' learning progress and understanding ability. For instance, Knewton's adaptive learning technology can monitor students' learning performance in real-time, timely adjusting the teaching content according to students' specific situations, ensuring that students can continuously progress at a pace that suits them best, significantly improving learning outcomes. The study by Dutta et.al (2024) has reported on favorable potential of Knewton's adaptive learning technology, alongside a few others, on the personalized learning paths and the impact on student engagement and outcomes. In brief, AI technology can assist educators for personalize learning to address achievement gaps.

Additionally, AI technology, through in-depth analysis of students' learning data, can timely identify problems in students' learning and provide personalized feedback and suggestions. For example, Learning Management Systems (LMS) use AI technology to conduct comprehensive and detailed analysis of students' learning behaviors, helping teachers gain a deep understanding of students' learning situations, thus providing targeted guidance and making teaching more precise and effective.

In addition, AI technology can provide virtual tutoring and support, helping students solve problems encountered in learning in a timely manner. For example, AI virtual tutoring systems can provide real-time tutoring and suggestions based on students' learning situations, acting like a caring learning partner, always available to help students, improving their learning effectiveness and confidence. Virtual tutoring support using AI-driven chatbots can answer students' questions in real-time, providing timely learning support and enhancing interaction between students and learning content, stimulating students' interest and enthusiasm for learning.

3.2 Reasons for adoption of AI Technology

In addition, AI technology can provide virtual tutoring and support, helping students solve problems encountered in learning in a timely manner. For example, AI virtual tutoring systems can provide real-time tutoring and suggestions based on students' learning situations, acting like a caring learning partner, always available to help students, improving their learning effectiveness and confidence. Virtual tutoring support using AI-driven chatbots can answer students' questions in real-time, providing timely learning support and enhancing interaction between students and learning content, stimulating students' interest and enthusiasm for learning One of the reasons for the adoption is because of the convenience and flexibility of learning. The application of AI technology greatly improves the convenience and flexibility of remote learning, allowing students to learn freely according to their schedules. Students are no longer restricted by the time and location constraints of traditional classrooms and can learn at their own pace and needs. A study (Yang, Huan & Yang, 2020) in Chongqing Three Gorges University, reported on the benefits for practical teaching, drawing the merits from Massive Open Online Course (MOOC) and Self-Paced Open Course (SPOC). These platforms improve the

convenience and flexibility of remote learning, allowing students to learn freely according to their schedules

Another reason for adoption is AI enhance richness of course content. AI technology can recommend rich and diverse course content based on students' interests and needs. For example, recommendation systems can accurately recommend relevant courses and resources based on students' learning records and preferences, enabling students to access more interesting learning content. Interesting content in turn, improves learning experience and psychological satisfaction (Lv, 2011). AI technology, by providing personalized learning experiences and support, enhances students' learning experience and psychological satisfaction AI Learning Platform at Chongqing University

Chongqing universities utilize the advantages of AI technology, to provide personalized learning support and tutoring for students. The platform provides personalized learning paths and resource recommendations by analyzing students' learning data, greatly improve students' learning outcomes and satisfaction (Zhao, 2023). For instance, the platform can recommend suitable courses and learning materials based on students' learning history and ability levels, and adjust learning plans in real-time according to students' learning progress, ensuring that students can steadily progress (Li, 2022). Other AI used includes virtual tutoring system, intelligent assignment grading system and intelligent speech recognition.

3.2.1 Virtual Tutoring System

AI virtual tutoring systems provide real-time learning support and tutoring for students. Information quality, system quality, service quality, perceived usefulness significantly affects satisfaction (Jin, 2023). It also helps students solve difficulties encountered in learning, reducing learning pressure, making students feel cared for and supported in learning, thus improving learning satisfaction. Virtual tutoring system that utilizes natural language processing technology, can understand students' questions and provide immediate feedback and suggestions, effectively increasing students' learning efficiency and engagement (Zhu, Zhao & Tang, 2023). For example, in intelligent teaching environment, students can ask questions to the virtual tutoring system anytime during their learning process (Yao et. al., 2023). The system will quickly provide detailed answers and guidance, helping students solve problems in a timely manner, maintaining learning continuity and enthusiasm.

3.2.2 Intelligent Assignment Grading System

Intelligent assignment grading system, which uses AI technology automatically grades students' assignments, including text, mathematical formulas, etc. The system can quickly and accurately judge the correctness of answers and provide detailed grading comments and analysis reports (Wang, 2022). For example, for math assignments, the system can provide correct solutions; for text assignments, the system can analyze grammar and spelling; and provide improvement suggestions. Such features greatly reduce teachers' grading burden, allowing them to focus more on teaching content design and personalized tutoring for students (Li 2021). Meanwhile, students can receive feedback in a timely manner, understand their learning situation, and adjust learning strategies accordingly.

3.2.3 Intelligent Speech Recognition

Intelligent speech recognition, which plays an important role in language learning courses is adopted. The system can recognize students' speech and evaluate their pronunciation, intonation, speech speed, etc. For example, in English speaking practice, students can record their readings or conversations, and the system will provide real-time scores and improvement suggestions, helping students improve their speaking skills. Additionally, the system can provide imitation

examples, allowing students to compare their pronunciation with standard pronunciation and conduct targeted practice. This personalized learning method stimulates students' learning interest, increasing their engagement, and learning outcomes.

3.2.4 Virtual Laboratory at Chongqing Universities

Virtual laboratories provides students with immersive experimental experiences. In virtual laboratories, students can conduct experimental operations through virtual reality equipment as if in a real laboratory. The system will evaluate and feedback on students' operations and results. For example, in physics experiments, students can perform circuit connections and observe physical phenomena, with the system simulating experimental results to help students better understand experimental principles. The application of virtual laboratories addresses the challenges of experimental teaching in remote education, allowing students to conduct practical operations in a remote environment, enhancing their hands-on abilities and problem-solving skills (Jingyi et.al., 2020).

The applications of AI technology in remote education at Chongqing universities provides students with more personalized, efficient, and convenient learning experiences, while also offer strong support for teachers' teaching (Deng et. al., 2024). However, the adoption comes with challenges.

3.3 Challenges and Issues

While these applications have achieved certain results, providing students with richer and more personalized learning resources and support, some issues still need further optimization and resolution, such as the stability of the technology, data security, and the adaptation ability of teachers and students to new technologies. Second Clinical College of Chongqing Medical University reported while ChatGPT is found to possess significant applicability and potential benefits, students and educators face numerous challenges in the learning process (Deng et. al., 2024). Some of the challenges are as the following:

3.3.1. Technical Adaptation Issues

Some students may not be very familiar with using AI technology. Students may need time to adapt and master the relevant tools and platforms (Yanshan, 2023). For example, students may feel confused when first using the AI learning platform, needing more time to get familiar with its functions, which initially affected their learning outcomes and engagement.

3.3.2 Data Privacy and Security Issues

The application of AI technology involves a large amount of personal data from students, such as learning behaviors and grades. University's AI system processes millions of data entries monthly, making the privacy and security of these data a crucial issue. If data leaks occur, it can seriously harm students' personal rights.

3.3.3. Network Connection Issues

A stable network connection is key to the smooth application of AI technology in remote learning. However, some regions may experience unstable network conditions. For example, in some remote areas, high network latency causes video buffering and slow platform responses, severely affecting students' learning experiences.

3.3.4. Lack of Interpersonal Interaction

Although AI technology can provide some interaction, it may still fall short compared to real human interaction. Long-term lack of interpersonal interaction affects the development of students' social skills and teamwork abilities, hence Chinese scholars support the cautious integration of AI into education as it serves as a learning tool that offers personalized educational experiences for students (Wang, 2022; Deng et. al., 2024). However, it also raises concerns related to academic integrity and the potential hindrance to students' critical thinking skills (Li, 2021; Liu, et.al., 2022)

3.3.5. Technology Fairness Issues

Not all students can equally benefit from AI technology. For example, some economically disadvantaged students may not have good equipment and network environments, affecting the quality of their participation in remote learning (Han & Trimi, 2022).

3.4 Improvement Measures

Improvement measures are necessary to harness the benefits of AI particularly by strengthening training and support. Universities can provide training courses and resources on using AI technology to help students better adapt to and utilize these technologies. Through training, students' familiarity with and ability to use AI technology can be significantly improved; therefore, setting up technical support teams to promptly resolve issues encountered by students during use ensures smooth utilization of AI technology for learning.

3.4.1 Ensuring Data Security

Universities should enhance data management and security measures to ensure the privacy and security of students' data (Li, 2022). This includes adopting advanced data encryption technologies, regularly scanning and fixing security vulnerabilities, and strengthening access management. Simultaneously, raising students' awareness of data security's importance can improve their security consciousness.

3.4.2 Optimizing Network Infrastructure

Governments and universities should increase investments in network infrastructure to improve coverage and stability. For example, a local government can invest in upgrading network equipment, reducing network latency, and improving stability to enhance students' remote learning experiences.

3.4.3 Promoting Interpersonal Interaction

Remote learning can be designed to include activities and tasks that promote interpersonal interactions among students and between students and teachers, such as group discussions and project collaborations. For instance, a university added group projects to its courses, significantly increasing student interaction and effectively improving their teamwork skills.

3.4.4 Bridging the Digital Divide

Universities can provide equipment and network support to help economically disadvantaged students improve their learning conditions. For example, offering free equipment rental services to poor students, allowing them to better participate in remote learning. In conclusion, to fully leverage the advantages of AI technology in remote learning, it is necessary to address and solve existing issues.

4.   CONCLUSION

This study aims to understand the application of AI technology in remote education, in Chongqing, China. Through previous studies highlighted previously, it shows that AI technology significantly enhances learning outcomes and student satisfaction. Specifically, the application of AI technology in remote education, such as intelligent learning platforms and virtual tutoring systems, provides students with personalized learning paths and real-time feedback and support. These technologies can deliver learning resources based on students' learning characteristics and needs, helping students develop reasonable learning plans, thereby effectively improving their academic performance. Additionally, the interactive learning environment created by AI technology stimulates students' interest in learning, increasing their engagement. Moreover, personalized learning experiences and timely learning support significantly enhance students' learning satisfaction.

Additionally, we should pay attention to the ethical and social issues that AI technology may bring in education, such as data privacy protection, algorithm bias, and the impact on students' autonomy and creativity. Ensuring the application of AI technology in education is reasonable and sustainable requires in-depth research on these issues and the formulation of corresponding policies and guidelines. In conclusion, the application of AI technology in remote education brings new opportunities and challenges to the education field.

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