Revolutionizing Online Learning: The Promise and Perils of Chatbots and Blockchain

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Abstract:

In the sphere of remote education, this study intends to investigate the current trends and difficulties associated with integrating chatbots and blockchain. This study provides a thorough overview of how these emerging technologies are being used and how they are affecting educational practices by synthesizing existing research using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. To improve transparency and security in educational transactions, blockchain technology is being used for smart contract implementation, academic record keeping, and safe credentialing. Simultaneously, chatbots are used to increase student engagement, accelerate administrative operations, and provide rapid, individualized student care. But there are obstacles to its acceptance, including issues with scalability, privacy, and the requirement for technological expertise. To comprehend the advantages, restrictions, and potential uses of these technologies in distant education, this study will methodically examine peer-reviewed publications published between 2020 and 2024 with an emphasis on their use in this context. The results will provide light on how chatbots and blockchain technology can be successfully incorporated into remote learning, resolving current issues and optimizing their potential to improve the student experience.

Keywords

E-Learning, Distance learning, chatbot, blockchain

1. Introduction

The dawn of the digital age has caused a significant and transformative change in the field of education. Online learning has become a crucial aspect of modern education as traditional classroom limitations disappear. The rapid progress of technology has led to the development of numerous technologies that aim to improve the learning process. Chatbots and blockchain technology have the potential to greatly enhance the quality, efficiency, and security of online education. Blockchain provides immutable records and safe transactions, whereas chatbots enable real-time, individualized student connection. A systematic review utilizing the PRISMA methodology, to follow the following research questions of the study

1. How can Blockchain improve online assessments' Transparency and Trustworthiness?
2. How can real-time Chatbot Personalization affect learning paths?
3. Is it Possible to develop a more secure and effective student data exchange system by using Blockchain and Chatbots together?

2. Methodology

This systematic analysis aims to improve security, transparency, and personalized learning experiences by examining how chatbots and blockchain technology could be integrated into online education. The PRISMA (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) framework is followed throughout the methodology to provide a thorough and open process for

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finding, filtering, and adding pertinent studies. The processes in this approach are explained in more detail below.

The following search phrases were used: "Blockchain in online assessments," "Chatbots in personalized learning," "AI in education," and "Technology integration in e-learning." The search results were filtered using Boolean operators. To narrow down the scope, the AND highlights studies that investigate the usage of blockchain technology and chatbots in educational environments. The OR to broaden the focus by incorporating research on blockchain or chatbots in the classroom.

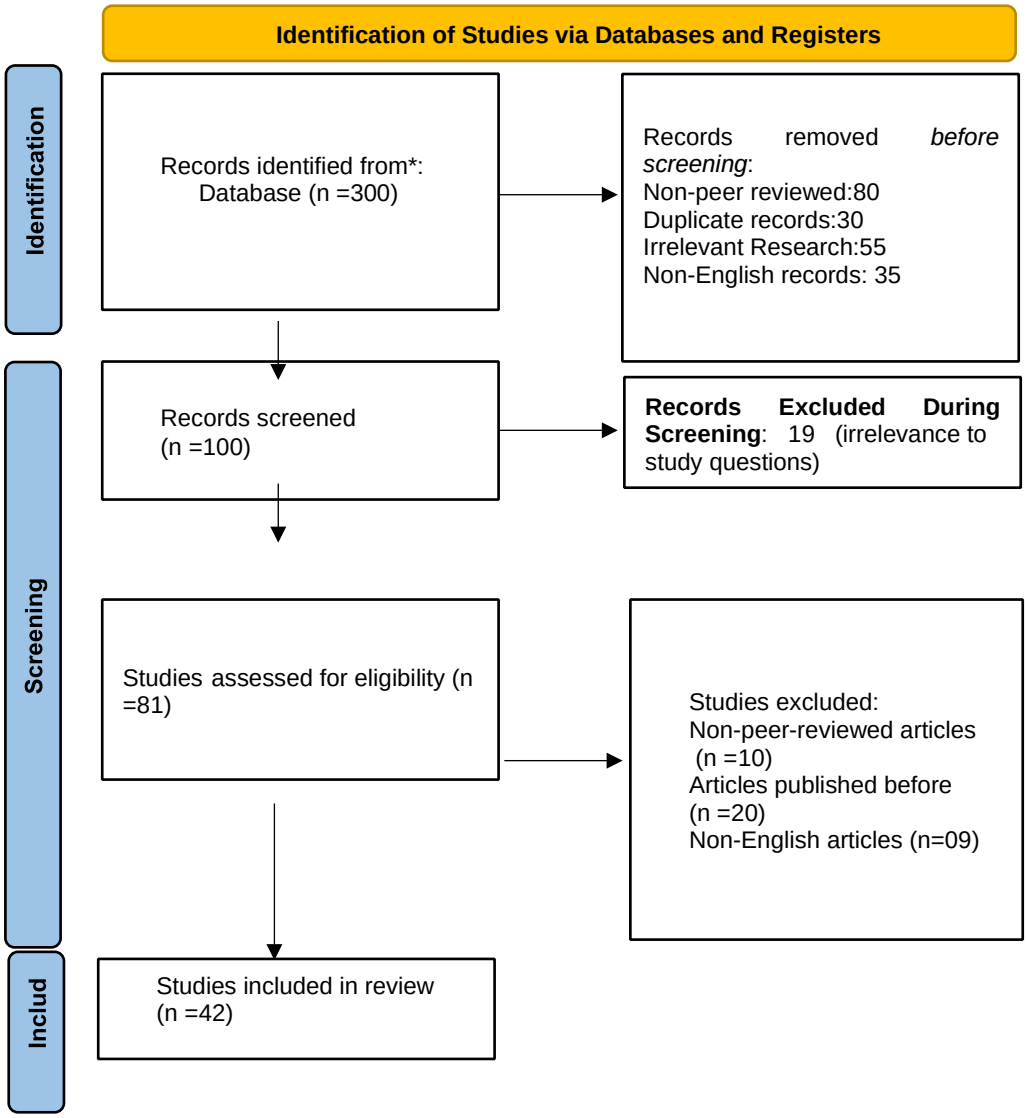

Figure 1: Adapted from a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram, customized for our study [1]

2.1. Inclusion and Exclusion Criteria

Research inclusion criteria are crucial in ensuring that enough studies satisfy quality standards and analysis requirements[2]. The inclusion criteria for this study focused on peer-reviewed works published in English between 2020 and 2024, ensuring that the review reflects recent advances in chatbots and blockchain in online education. Articles focused on the educational uses of these technologies, such as trust enhancement, individualized learning, and secure data exchanges, were included.

To guarantee that only acceptable papers were chosen for examination, exclusion criteria were used, offering a thorough knowledge of academic dishonesty in online learning settings [3].To ensure academic rigor, non-peer-reviewed literature, conference abstracts, and opinion articles were excluded from consideration. Duplicate entries were eliminated, and non-English articles were excluded for language accessibility. Studies that did not properly address the research issues or lacked empirical data were also removed. This method resulted in the removal of 200 records, including 80 non-peer-reviewed, 30 duplicates, 36 non-English, and 55 irrelevant research. After using these criteria, 42 papers were selected for the final analysis, assuring relevance, quality, and a focus on the integration of blockchain and chatbots in online education.

The initial database search identified 300 records. After applying the exclusion criteria (removing duplicates, non-peer-reviewed articles, etc.), 100 studies were thoroughly screened. This required analyzing each study's title, abstract, and keywords to determine its relevance to the research topics. Following this screening, 81 studies were considered eligible for full-text review.

After a full-text review, 42 studies were selected for the final analysis. These studies serve as the foundation for literature evaluation and are organized according to the research emphasis areas indicated in the study.

3. Literature Review

3.1. Blockchain Technology in Online Assessments

Blockchain technology in education facilitates transparent data management and verification. It is believed that blockchain technology will significantly transform the educational environment. Blockchain technology has the potential to significantly change how educational institutions handle student data and how students and teachers communicate. Blockchain technology has the potential to streamline worldwide certification processes and enhance student-centered learning environments, hence improving educational sustainability and promoting lifelong learning [4]. When it comes to protecting student and instructor information, the system's security, and other related concerns, blockchain technology is the way to go. Among the several benefits of blockchain technology are its decentralized nature, immutability, transparency, and the elimination of double spending and distributed ledgers [5, 6]. Education stands to gain a great deal from blockchain technology, which offers several potential advantages, such as increased security at a reduced cost, improved student assessments, more control over data access, greater accountability and transparency, improved trust, more efficient record management, career decision support, and improved student interaction.

Blockchain technology in education offers a secure, temper-proof digital transcript, eliminating the need for traditional paper-based transcripts, which can be easily lost or destroyed [7].

3.1.1. Transparency and Trustworthiness

Blockchain technology offers a solution to existing evaluation methodologies' shortcomings due to rapid technical advancements. Blockchain's immutability, decentralization, and cryptographic security make it a promising tool for establishing trust and transparency in student assessments. E-Learning IoT systems address security concerns in online education, particularly student record security and privacy. Blockchain technology offers decentralization, immutability, transparency, double spending, and distributed ledgers, addressing system security challenges and ensuring student and instructor records privacy [8]. The blockchain technology improves transparency and trustworthiness in student assessments by offering safe, immutable records and transparent processes [9]. Blockchain technology improves transparency and reliability in academic certificate verification by providing secure, immutable records, eliminating fraud and enhancing stakeholder confidence [10]. The research conducted by Abdelsalam, Idrees, and Shokry explores the ways in which blockchain technology improves the visibility and reliability of online examination outcomes. The framework utilizes blockchain's decentralized and tamper-proof characteristics to guarantee

data integrity, so avoiding illegal alterations and establishing a dependable and transparent platform for academic evaluations [11].

Applied Soft Computing proposes a probabilistic and trustworthy language model for evaluating blockchain-based student information management systems. It underlines how blockchain improves openness and reliability by ensuring safe, tamper-proof data storage and reliable assessment of student information [12]. The case study shows that implementing blockchain technology into information systems greatly increases security and reliability. It achieves this by ensuring data immutability, promoting transparency, and adopting decentralized control, hence reducing system vulnerabilities and increasing user confidence [13]. Blockchain technology can assure assessment fairness, respect for course and exam dates, and urge students and teachers to continue their efforts even from home [14].

Blockchain technology enhances the management of distant education by securely preserving learning records in a reliable and decentralized manner. It also facilitates the issuance of trustworthy digital certificates, enables the sharing of learning resources, and safeguards intellectual property using data encryption [15]. In order to increase the confidence and dependability of educational systems, [16] investigates how blockchain technology can safeguard online examinations by guaranteeing data integrity, transparency, and tamper-proof records.

3.1.2. Implementation challenges

Blockchain technology increases online learning administration by facilitating instructional resources, process control, evaluation, and management, as well as collaborative participation between professors and students [17]. Few research has addressed comprehensive academic records including learning behavior logs and evaluation data; instead, current education blockchain systems concentrate on reporting and certifying academic credentials. Implementing blockchain technology in educational settings presents challenges, such as learning management system security and technological problems [7].

Implementing blockchain technology to online learning systems can be hard because of data protection rules, problems with scalability, and problems with market adoption and new ideas [18]. Compatibility and other important aspects influence blockchain implementation in smart learning settings [6]. The integration of blockchain technology in online learning systems presents both technical and non-technical issues. These include the establishment of decentralization and security, as well as the management of learning records and certificates [19]. Incorporating blockchain technology into online learning systems is still hard because of problems with legality, immutability, and scale [20]. The technology, organization, and environment (TOE) framework is used to categorize 15 major obstacles to HEIs adopting blockchain technology [21].

Addressing privacy procedures and guaranteeing efficient data protection are among the challenges and future goals for the successful implementation of blockchain technology in education [22]. These all studies show that different challenges in implementing blockchain technology in the online education system related compatibility scalability and privacy protection and some technical barriers.

4. Chatbots for Personalized Learning

In recent years, there has been a noticeable increase in interest in the usage of chatbots in personalized learning environments. By offering personalized feedback, engaging information, and flexible learning pathways, these conversational agents are being included into educational systems to improve the quality of learning.

Chatbots can help with both schoolwork and office work. They can create a comfortable setting for people who aren't very good with technology and make it easier for students and teachers to talk to each other [23]. Integrating contextual bandit algorithms in chatbots allows for personalized learning by adjusting the pace of learning and offering customized feedback and practice problems. This approach can be equally effective as traditional learning sites like Khan Academy [24]. Positive

perceptions of chatbots are shared by educators and learners, who highlight their convenience, improved functionality, instantaneous feedback, and capacity to replicate interaction cycles for practice [25].

Chatbots can adapt to learners' abilities and pace, delivering individualized education while improving motivation and independent learning [3, 26]. Chatbots function as supplementary educational technologies that aid in academic and administrative activities, enhancing communication between students and academic personnel. Chatbots function as supplementary educational technologies that aid in academic and administrative activities, enhancing communication between students and academic personnel [23].

Personalizing chatbots in real-time can have a good effect on learning paths by adjusting to individual needs, allowing interactions across different platforms, improving communication, and increasing motivation and learning results. This method enhances the knowledge acquisition process, especially in language learning and educational environments that incorporate game elements.

4.1. Adaptive Learning Environments

Chatbots are emerging as a viable technique in the field of personalized learning through technology in adaptive learning settings. These conversational agents powered by AI can offer a variety of subjects and user groups personalized, dynamic, and interesting learning experiences.
While quick chatbot interventions can encourage learning, longer or more intensive interactions may be required to reach notable behavioral changes or deeper learning results [27]. AI chatbots can act as supportive agents, aiding students during periods of self-directed online learning. The MERLIN initiative showcased the ability of chatbots to inspire students, enhance learning results, and elevate the overall online learning experience [28].

During the COVID-19 epidemic, a course change meant to improve student mental wellness and awareness of nature as an adaptive complex system was instituted. The intervention consisted of field activities encouraging inquiry and curiosity, thereby fostering mental wellness and a better knowledge of environmental complexity. This method effectively combined psychological recovery with analytical courses to create more resilience and environmental values among pupils [29].

Four forms of learning adaptability were found in a study on the link between college students' mental health in an information-based teaching environment. The results showed that kids who possessed superior learning adaptation also had better mental health. This implies that supporting students' mental health could depend much on adaptive learning environments [30]. Chatbots can also be useful in providing concise, self-directed digital interventions for parents, assisting them in acquiring and implementing positive parenting techniques. While the initial effects may be restricted, these treatments demonstrate potential for fostering significant involvement and acquisition of knowledge [27].

To create efficient technology-enhanced learning environments (TELEs) for mathematics instruction, researchers utilized qualitative data from teachers to construct student personas. These personas embody prototypical pupils with distinct requirements, facilitating technology developers in crafting pertinent and efficient instructional aids. This approach can be applied to many educational settings to enhance the development of adaptive learning systems [31].

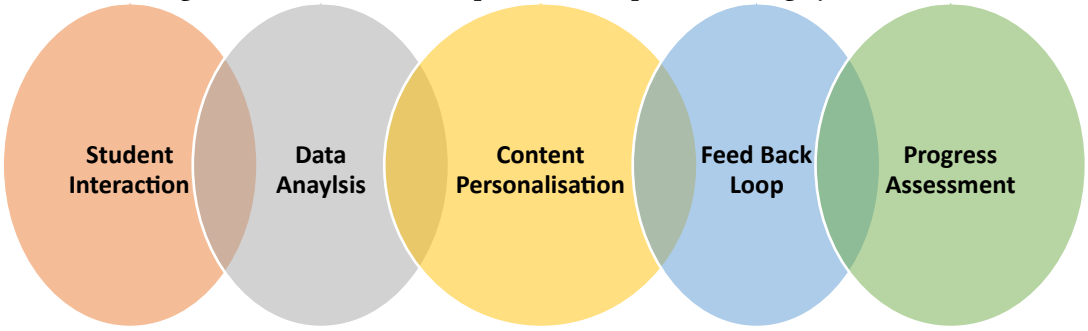

Figure 2: Classification of Studies Based on Research Focus Areas in Adaptive Learning

4.2. Limitations and Concerns

Chatbots have become very popular and have a wide range of uses, especially those that are driven by sophisticated AI like ChatGPT. Nevertheless, there are several restrictions and issues with their utilization that must be resolved.

Chatbots, particularly complex models such as ChatGPT, can create incorrect or false material, raising questions about their reliability in educational settings [32, 33]. Chatbots frequently lack the ability to provide appropriate interaction and engagement, which are required for effective online learning. This constraint is most noticeable when pupils are studying independently without adequate scaffolding activities [23].

Many chatbots have technical controls that reduce their efficacy in the teaching and learning process. These include issues in giving suitable instruction and information, particularly for less tech-savvy people [23, 34].

The use of chatbots in education raises ethical concerns, such as the possibility that students will misuse these technologies to cheat. Concerns have been raised concerning the lack of critical thinking and originality in student work when depending primarily on chatbots [33]. Although chatbots can be programmed to aid those with cognitive impairments, the task of making these technologies accessible and inclusive for all pupils still poses a difficulty. The efficacy of chatbots in addressing a wide range of learning needs and abilities is now being examined [35].

Chatbots in online education offer potential advantages as well as difficulties. Although dynamic and entertaining, educational tools have constraints in terms of engagement, technological reliability, accuracy, ethical use, inclusivity, and data currency, which must be controlled with caution. To fully optimize the advantages of chatbots in educational environments, it is crucial to address these challenges.

5. Integrated Use of Blockchain and Chatbots

Artificial intelligence and blockchain have significantly joined in blockchain-integrated chatbots, resulting in a transformative combination of these two technologies [36].

The study [36] investigates the integration of blockchain technology with chatbots to improve the security, transparency, and trustworthiness of automated interactions. It focuses on decentralized data management and the ability to verify transactions in chatbot discussions. The goal of the study "Development of a question answering chatbot for blockchain domain" [37] is to improve accessibility and comprehension of the domain by developing a chatbot that can respond to inquiries about blockchain technology.

The study [38] investigated the possibility of combining blockchain technology with generative AI to develop innovative educational solutions. It investigates how these technologies might be used to improve teaching and learning processes, resulting in safe, individualized, and efficient educational experiences for students and teachers.

The study [6] investigated the implementation of blockchain technology in intelligent learning settings, specifically emphasizing its effects on improving security, transparency, and efficiency within educational systems.

5.1. Risk of Integrating Blockchain in Chatbot

The integration of blockchain technology with chatbot systems poses significant dangers, including those related to privacy, regulation, finance, technology, fraud, and operations [39]. Blockchain technology provides effective and efficient solutions to the potential to use IoT. But face many difficulties in terms of storage capacity and scalability, resource consumption, transaction rate scalability, predictability, and legal concerns [40].

The integration of blockchain technology in supply chain management is correlated with a significant risk of privacy [39]. Utilizing blockchain technology along with attributes and homomorphic encryption can reduce possible threats to user privacy in chatbot technology [41]. To

ensure the ethical use of AI in education they emphasizes the importance of algorithm caution, a practice that manages and mitigates the negative impacts of algorithms in AIpowered mobile applications designed for educational purposes [42].

6. Conclusion

This study investigated the revolutionary potential of chatbots and blockchain technology in the context of online education. Our systematic review show that blockchain technology improves transparency and security in online assessments due to its decentralized and immutable nature, while chatbots considerably contribute to personalized learning experiences by dynamically adjusting to individual learning requirements. Despite these benefits, issues such as scalability, privacy concerns, and the requirement for technological competence must be addressed to promote widespread usage. The combination of blockchain and chatbots offers a potential opportunity to create secure and efficient educational systems. Future research should address the creation of scalable blockchain solutions for academic settings, enhancement of chatbot skills to serve different learning environments, and the ethical considerations surrounding these technologies to ensure their responsible use.

7. Future Direction

Future study should investigate using blockchain technology to raise transparency and trust in online exams and credential verification. Creating powerful, real-time adaptive chatbots can tailor learning sessions while increasing student engagement and recalling. Integrating blockchain with AI-driven chatbots has the potential to create safe, reorganized solutions for managing student data and academic records. To improve online exams, future research should investigate using blockchain to create tamper-proof digital assessments and AI-driven analytics to detect and prevent cheating. Addressing scalability and privacy concerns is critical for larger use, personalized online learning, efficient, resulting in safer environments.

Declaration on Generative AI

The author(s) have not employed any Generative AI tools

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