



# Blockchain In Education : Challenges and Application

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**Abstract:** This paper explores the potential of blockchain technology in the education sector, aiming to address its traditional challenges and inefficiencies. While technological advancements have proliferated, the higher education system in developing countries has remained largely unchanged. The study presents a bibliometric and qualitative analysis of blockchain in education, emphasizing its temporal development, emerging themes, and practical case studies. Notably, blockchain's prominence in education surfaced around five years ago, with a focus on verifying academic certificates and transcripts. However, limited efforts have been directed towards comprehensive academic records reporting and connectivity, hindering interoperability. To overcome these obstacles, the paper proposes an education blockchain based on learning outcomes and graduation requirements, facilitating continuous curriculum improvement and post-job competence evaluation. The study highlights blockchain's potential in revolutionizing education by enhancing security, accessibility, and transparency, demanding further research and experimentation for its successful integration.

**Keywords:** Blockchain, Education, Challenges, Applications, Transparency.

## I. INTRODUCTION

Blockchain technology gained widespread recognition following the widespread adoption of Bitcoin. Initially, its primary application was limited to financial and trading transactions. However, numerous studies have highlighted the versatility of blockchain, showcasing its potential to create systems beyond the scope of finance and trade. This adaptability is largely attributed to the high level of transparency inherent in blockchain technology. For instance, in the context of Bitcoin, the distributed structure of wallets allows for swift and transparent tracking of the total number of coins and transaction volumes worldwide. Moreover, this system operates on a peer-to-peer (P2P) basis, eliminating the need for a central authority to approve or execute operations.[1]

Additionally, blockchain can facilitate the development of decentralized learning platforms, where students, educators, and institutions can directly interact and collaborate without intermediaries. Such platforms promote peer-to-peer learning, reduce administrative costs, and foster a global community of learners with diverse perspectives and experiences. Smart contracts, another vital aspect of blockchain technology, can automate various administrative processes, such as tuition fee payments and certification issuance, ensuring accuracy and efficiency in the education ecosystem.

Moreover, blockchain enables the creation of micro-credentials, recognizing smaller achievements and competencies. These digital badges provide a standardized and verifiable system for students to showcase their skills and accomplishments. Furthermore, blockchain offers data privacy and security enhancements, safeguarding sensitive student information from potential data breaches and unauthorized access.

Through blockchain adoption, educational institutions can streamline administrative processes, reduce reliance on intermediaries for record verification, and empower students to control their academic credentials. The technology also facilitates secure and seamless transfer of academic records between institutions, ensuring data accuracy and smoother transitions for students.

By streamlining student enrollment and data transfer, blockchain reduces administrative burdens and minimizes errors, allowing for quick and secure sharing of academic records between educational institutions. It also has the potential to significantly impact international education, simplifying the verification and evaluation of foreign academic credentials, which can be costly and time-consuming.



Embracing blockchain in education presents an opportunity to create a more inclusive, efficient, and accessible learning environment. By leveraging its potential, educational institutions can empower learners, educators, and other stakeholders with a robust and future-ready framework that unlocks the true potential of education in the digital age.

This introduction lays the groundwork for exploring the various applications, challenges, and opportunities presented by blockchain in the education sector. As the technology continues to evolve, education stakeholders recognize its transformative potential and actively seek ways to leverage its benefits for the advancement of global education.

## II. APPLICATIONS OF BLOCKCHAIN IN EDUCATION SECTOR

Blockchain technology has the potential to revolutionize the Education industry by addressing various challenges related to data security, interoperability, privacy, and transparency.

Below are some of the key applications of blockchain in education:

1. Credential verification and academic records: Blockchain can serve as a secure and tamper-proof system to store academic records, degrees, certificates, and other credentials. Students can have their achievements recorded on the blockchain, making it easier for employers and educational institutions to verify their qualifications. [4]

2. Digital identity and authentication: Blockchain can enable a decentralized and self-sovereign digital identity system for students and educators. This can reduce identity fraud and simplify the authentication process for accessing educational resources and services. [4]

3. Smart contracts for administrative tasks: Smart contracts can automate administrative processes such as student enrolment, course registration, and fee payment. This reduces paperwork and administrative overhead, leading to more efficient operations. [3]

4. Open educational resources (OER): Blockchain can be used to create decentralized platforms for sharing and distributing open educational resources. This enables educators to share content and get rewarded directly, promoting collaboration and resource accessibility.

5. Micro-credentials and lifelong learning: Blockchain can facilitate the creation and verification of micro-credentials, which are smaller, focused certifications that showcase specific skills. Students can accumulate these credentials from various sources throughout their lives, creating a more dynamic and flexible learning journey.

6. Decentralized learning platforms: Blockchain can power decentralized learning platforms that connect students directly with educators, removing intermediaries and providing more control over the learning experience.

7. Secure examinations and anti-plagiarism: Blockchain can enhance the security and integrity of online examinations by providing a tamper-proof record of test results. Additionally, it can be used to detect and prevent plagiarism in academic submissions.

9. Funding and financial aid distribution: Blockchain can be employed to streamline the distribution of financial aid and scholarships. Transparent transactions can ensure that funds reach the intended recipients efficiently.

12. Global student mobility and credit transfer: Blockchain can simplify the process of credit transfer between educational institutions, making it easier for students to continue their studies abroad.

While blockchain holds great promise for transforming education, it's important to recognize that implementation challenges and regulatory considerations must be addressed to realize its full potential in the education sector.

## III. BENEFITS OF BLOCKCHAIN IN THE EDUCATION SECTOR

Blockchain technology offers several benefits to the Education sector due to its decentralized, secure, and transparent nature.

Some of the key advantages of using blockchain in Education include:



1. **Immutable Records and Data Security:** Blockchain provides a decentralized and immutable ledger, ensuring that educational records, certifications, and achievements cannot be altered or tampered with. This enhances the integrity of the educational data and reduces the risk of fraud or unauthorized changes.
2. **Verified Credentials and Certifications:** With blockchain, educational institutions can issue digital certificates and credentials that are cryptographically secured. This enables employers and other educational institutions to easily verify the authenticity of a candidate's qualifications without contacting the issuing institution directly.
3. **Transparent and Trustworthy Credentialing System:** Blockchain allows for a transparent and trustworthy credentialing system where all the educational achievements of a student are recorded on the blockchain. This eliminates the need for a central authority to validate credentials, making the process more efficient and less prone to errors or bias.
4. **Easy Transfer of Credits:** For students who transfer between educational institutions, blockchain facilitates a smooth and secure transfer of credits. It ensures that academic achievements from one institution are easily recognized and accepted by another, streamlining the credit transfer process.
5. **Micro-Credentialing and Lifelong Learning:** Blockchain enables the creation of micro-credentials or badges for completing small courses or acquiring specific skills. These micro-credentials can be stored on the blockchain, making it easier for students to showcase their continuous learning and skill development throughout their lives.
6. **Privacy and Data Control:** With blockchain, students have more control over their educational data. They can grant access to specific educational records to different parties while keeping other personal information private. This feature helps in complying with data protection regulations like GDPR.
7. **Reduced Administrative Burden:** The decentralized nature of blockchain reduces the administrative burden on educational institutions. Processes like student enrolment, record-keeping, and certification issuance can be automated and made more efficient, freeing up resources for other critical tasks.
8. **Global Collaboration and Research:** Blockchain facilitates secure collaboration among researchers, institutions, and academics worldwide. It allows for the creation of shared research databases while ensuring that intellectual property rights and contributions are properly attributed.
9. **Easier Accreditation Processes:** Blockchain can streamline the accreditation process for educational institutions. Accrediting bodies can access verified information directly from the blockchain, simplifying the assessment and evaluation of institutions' standards and quality.
10. **Financial Transactions and Smart Contracts:** Educational institutions can use blockchain to handle financial transactions, such as tuition payments or scholarship distributions, securely and transparently. Smart contracts on the blockchain can automate these processes, ensuring timely and accurate transactions.

In summary, blockchain technology offers the education sector enhanced security, transparency, efficiency, and flexibility, making it a promising tool for transforming how educational data is managed and shared in the future.

#### IV. NEED OF BLOCKCHAIN IN EDUCATION

Blockchain technology has the potential to revolutionize the education sector in several ways. Its decentralized, transparent, and immutable nature can address critical challenges. Firstly, blockchain can securely store and verify academic credentials, eliminating the risk of fraudulent degrees and simplifying the verification process for employers and institutions. [2]

Secondly, it can enhance data privacy, empowering students to control access to their personal information. Thirdly, smart contracts on the blockchain can automate administrative tasks like enrollment, fee payments, and certification issuance, streamlining processes and reducing administrative burdens. [3,4] Additionally, blockchain-based tokens or cryptocurrencies can incentivize learning, gamifying education and encouraging skill development. Lastly, the global nature of blockchain can facilitate easy cross-border collaboration among educational institutions. While blockchain is not a panacea, its integration in education can foster trust, efficiency, and innovation, empowering students and institutions alike in a rapidly evolving digital age.



Some key reasons why there is a need for blockchain in education are as follows:

1. **Credentials and Certifications Verification:** Blockchain can provide a secure and tamper-resistant way to store and verify academic credentials, degrees, and certifications. Students' achievements can be recorded on the blockchain, and employers or other educational institutions can easily verify their authenticity without relying on centralized databases or third-party verification services.
2. **Data Security and Privacy:** Educational institutions handle sensitive student data, including personal information, grades, and attendance records. Storing this data on a blockchain with robust encryption ensures a high level of security and privacy, reducing the risk of data breaches.
3. **Eliminating Academic Fraud:** With traditional systems, academic fraud, such as forging degrees or certificates, is a concern. Blockchain's immutability and transparency make it difficult for individuals to falsify their educational achievements, enhancing the credibility of the education system.
4. **Micropayments and Student Support:** Blockchain-based cryptocurrencies can facilitate micropayments, enabling students to access course materials or pay for small educational services more easily. It can also streamline financial aid distribution and enable targeted student support.
5. **Lifelong Learning and Skills Tracking:** Blockchain can help create a lifelong learning record for individuals, enabling them to document their continuous learning and skills development. This information can be beneficial when seeking new job opportunities or career advancements.
6. **Transparent Fund Management:** Educational institutions often manage funds for research projects, scholarships, and other initiatives. Using blockchain for fund management can provide transparency and accountability, ensuring that funds are allocated and utilized as intended.
7. **Global Accessibility:** Blockchain can facilitate borderless education by enabling secure and verifiable online education platforms. This can benefit students worldwide, particularly in regions with limited access to traditional educational resources.
8. **Smart Contracts for Administrative Processes:** Smart contracts, self-executing agreements with predefined rules, can streamline administrative processes in education. For example, they can automate tasks like enrollment, grading, and course registration, reducing administrative burdens on staff and improving efficiency.
9. **Decentralized Learning Platforms:** Blockchain can power decentralized learning platforms where educational content is crowd-sourced and owned by educators or learners directly, fostering a more collaborative and inclusive learning environment.
10. **Research and Intellectual Property Management:** Blockchain can assist in managing intellectual property rights and tracking research contributions, making it easier to credit and reward researchers for their work.

While the potential benefits of blockchain in education are promising, it's essential to acknowledge that implementing such technology on a large scale would require overcoming various challenges, such as ensuring scalability, interoperability, and addressing regulatory concerns. Nevertheless, ongoing developments in blockchain technology could bring significant positive changes to the education landscape in the future.

## V. SECURING EDUCATIONAL DOCUMENTS IN BLOCKCHAIN

Securing education documents using blockchain technology brings a multitude of benefits that can significantly improve the management and verification of academic credentials. One of the key advantages is the heightened security and tamper-resistant nature of the blockchain. By storing document hashes on a decentralized ledger, the authenticity and integrity of each record are guaranteed, making it extremely difficult for unauthorized parties to alter or forge documents. This heightened security instills greater trust among educational institutions, employers, and students, ensuring that academic achievements are accurately represented.

Another significant benefit is the empowerment of students through increased data ownership and control. In a traditional system, educational records are often held and managed by institutions, limiting the individual's control over their data.



Blockchain allows students to own their digital credentials, granting them the authority to share verified information securely with potential employers or other educational institutions. This control over personal data aligns with data privacy principles and provides students with a sense of autonomy over their academic achievements.

The adoption of blockchain in the education sector also reflects a commitment to embracing technological advancements. As various industries undergo digital transformations, integrating blockchain demonstrates an institution's dedication to modernization and innovation. Such initiatives can enhance an institution's reputation, attract tech-savvy students, and improve overall competitiveness.

Thus securing education documents using blockchain technology offers a myriad of benefits, including enhanced security, streamlined verification, reduced administrative burdens, and increased data ownership for students. While challenges may arise during implementation, the potential rewards make blockchain a compelling solution for the secure and efficient management of academic credentials in the digital age. Embracing this transformative technology can position educational institutions at the forefront of innovation, ensuring they remain competitive and relevant in an increasingly digitized world.

## VI. CHALLENGES IN BLOCKCHAIN IN EDUCATION SECTOR

Blockchain technology has the potential to revolutionize the education sector, offering various benefits such as secure credentialing, transparent records, and decentralized learning platforms. However, several challenges hinder its widespread adoption and implementation in the education sector. Some of these challenges include:

1. Scalability: Blockchain networks can face scalability issues when dealing with a large number of transactions, which can be a significant problem for educational institutions with thousands or even millions of students. As more data is added to the blockchain, it can slow down the network, making it less efficient for real-time processing of educational activities.[2]
2. Cost: Implementing and maintaining a blockchain network can be expensive, particularly for educational institutions that may already have tight budgets. The costs associated with hardware, software, and technical expertise required for blockchain integration can be a barrier to adoption.[4]
3. Technical complexity: Blockchain technology is relatively complex, and not all educators and administrators may have the necessary technical knowledge and expertise to manage and operate blockchain systems effectively. Training and educating staff on blockchain technologies can be time-consuming and resource-intensive.
4. Regulatory and legal considerations: The use of blockchain in education raises questions about data privacy, ownership, and compliance with existing regulations. Ensuring that student data is adequately protected and adheres to relevant laws, such as the General Data Protection Regulation (GDPR), can be challenging.
5. Interoperability: Different educational institutions and systems may use different blockchain platforms or protocols, leading to interoperability issues. For blockchain to truly benefit education, there needs to be a standardized approach that allows seamless data exchange and sharing between various institutions and platforms.[2]
6. Adoption and resistance to change: The education sector, like many other industries, can be resistant to adopting new technologies and methodologies. Convincing stakeholders to embrace blockchain in education may require overcoming skepticism and demonstrating its value in terms of security, efficiency, and data management.
7. Energy consumption: The energy-intensive consensus mechanisms used in many blockchain networks, such as Proof of Work (PoW), can have environmental impacts. Educational institutions must consider the ecological implications of running blockchain networks and seek more sustainable alternatives.
8. Identity verification: While blockchain can enhance the security of student credentials and achievements, verifying the real-world identity of individuals before adding them to the blockchain remains a challenge. Solutions are needed to ensure that the data entered into the blockchain accurately corresponds to the individuals claiming it.
9. Smart contract risks: Smart contracts on blockchain networks are not immune to coding errors or vulnerabilities. In an educational context, this could lead to issues such as incorrect grading, improper credential issuance, or other critical errors affecting students and institutions.[3]



Despite these challenges, blockchain technology continues to evolve, and efforts are ongoing to address these obstacles. As the technology matures and gains wider acceptance, the benefits it brings to the education sector may well outweigh the challenges.

## VII. CONCLUSION

In conclusion, blockchain technology offers significant potential in the education sector, particularly in addressing the issue of education certificate fraud. By leveraging the decentralized and immutable nature of blockchain, educational institutions can create secure and tamper-proof digital records of academic achievements, certifications, and degrees. This would not only streamline the verification process but also eliminate the risk of fraudulent certificates and credentials.

Blockchain can provide a trusted and transparent system where educational records are securely stored, verified, and shared in real-time, ensuring that only authorized parties have access to this sensitive information. This can greatly reduce the chances of individuals misrepresenting their educational qualifications or attempting to forge certificates.

Furthermore, the adoption of blockchain in education can help to foster trust and credibility in the academic ecosystem. Employers, academic institutions, and other stakeholders can easily verify the authenticity of a candidate's qualifications, enhancing the hiring process and promoting meritocracy.

However, it is crucial to address some challenges associated with blockchain implementation, such as data privacy concerns, scalability, and interoperability between different blockchain platforms. Additionally, promoting widespread adoption and standardization of blockchain-based credentialing systems requires collaboration among educational institutions, governments, and technology providers.

Overall, blockchain's potential to combat education certificate fraud is promising, and its successful integration can revolutionize the education sector by providing a robust, efficient, and secure verification process for academic credentials. As the technology continues to mature, the educational landscape can benefit from increased transparency, trust, and authenticity in certification processes.

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