



Author Notification
10 January 2023
Final Revised
13 January 2023
Published
15 January 2023

Blockchain Applications in Education Affecting Challenges and Problems in Digital

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Warry Saputra, M. A., Ochtaffia, D., Apriani, D., Yusfi, S. C., & Gori, M. (2022). Blockchain Applications in Education Affecting Challenges and Problems in Digital. Blockchain Frontier Technology, 2(2), 15–23.

DOI: <https://doi.org/10.34306/bfront.v2i2.155>

Abstract

Blockchain is thought to have a significant potential to offer a wide range of benefits for education development because of its special properties of decentralization and security. Its use in schooling is quite new. new but expanding swiftly. This paper described the standard blockchain. Briefly describe procedures and qualities. then, current blockchain applications thorough summaries of the findings in education, especially those Learning record keeper, decentralized education ecosystem, and credential issuance and management. The final topic of discussion was obstacles, both technical and otherwise. It is intended to give a thorough examination of the potential applications of blockchain. aid in the creation of new application systems and assist in the evolution of education.

Keywords: Status, Problems, Education, Blockchain, Application Challenges

1. Introduction

A developing technology called the blockchain was first mentioned in Satoshi Nakamoto's initial paper "Bitcoin: A Peer-to-Peer Electronic Cash System." Since then, blockchain has gained popularity as a method of transferring value and has aided in the successful introduction of a number of cryptocurrencies, including Bitcoin, Litecoin, and Ethereum. After mainframes, PCs, the Internet, and mobile/social networking, academics now think that this technology has the potential to become the fifth disruptive computing paradigm. Currently, there are a growing number of blockchain applications emerging in a variety of industries, with the financial sector being the most common to do so [1]. For the purpose of continuously improving the blockchain in banking, more than 300 businesses joined the alliances of R3 or Ethereum [2]. The US Nasdaq's blockchain technology Linq is used to carry out and record private securities transactions. It is now thought to have the potential to change the established financial system and drastically lower transaction costs. The use of blockchain in the energy sector has also advanced scientific inquiry and technological advancements. According to Siemens, LO3 Energy is a piloted microgrid development platform that focuses on local energy trade [3]. Energy point-to-point transactions have been made easier because of the microgrid that Transactive Grid is hosting in Brooklyn, New York. The blockchain network was used for the transaction, which allows residents to sell their extra solar electricity to their neighbors [4]. As a result, the transaction can be handled and documented without the involvement of staff. Blockchain technology has assisted in addressing the information island

problem in the medical industry. Blockchain enables the sharing of medical data with high access security, scalability, and data privacy [5]. Medical data is typically held in many organizations. In turn, it encouraged efficient medical care. According to reports, blockchain applications in the food industry have the potential to reduce food waste, a global issue that is getting worse. Blockchain's decentralization, verifiability, and immutability have the potential to assist education development in a variety of ways. Numerous application instances have illustrated the enormous potential [6]. Blockchain research in education is, however, still in its infancy, and application. Therefore, it is important to examine earlier research, comprehend its benefits and drawbacks, and identify its disruptive potential. The rest of this essay was structured as follows. Blockchain technology and its properties, which are crucial to education technology, were briefly introduced in Section 2. Then, in Section 3, a summary of prevalent blockchain uses in education at the time was provided. Following the discussion of current problems and difficulties in Section 4, this paper's conclusion in Section 5 followed [7].

2. Bitcoin technology and its features

2.1 The blockchain idea

Blockchain can be characterized as a connected list of blocks in its most basic form. One block header and one block body are the two major components of each block in the blockchain. The transactional information is stored in the block body. The previous block's hash value is stored in the block header and linked to from there. As a result, the blocks are linked together to form a chain on which the full history of every transaction is stored [8].

2.2 Blockchain technologies that are essential

Instead of being a single technical system, blockchain is a comprehensive one. Consensus technology, encryption technology, smart contracts, and distributed data storage make up the majority of its key technologies. Blockchain is actually a type of distributed ledger, which provides the basis for consensus [9]. Each participant has a copy of the ledger and the right to edit and maintain the database. A consensus mechanism is a set of guidelines or protocols that guarantees that all participants are reading from the same version of the ledger, preventing tampering with the blockchain data kept in each node [10]. Currently, proof of stake (PoS), proof of work (PoW), delegated proof of stake (DPoS), and other consensus procedures are common. Data on the blockchain is encrypted using an encryption technique, which is essential. Blockchain's data security will be questioned once the encryption algorithm is broken, and it will lose its immunity [11]. Symmetric and asymmetric encryption algorithms can be used to separate the commonly used encryption algorithm. The asymmetric encryption algorithm is mostly utilized on the blockchain. "Public key" and "private key" are used by the encryption techniques to encrypt and decrypt data [12]. Only its corresponding key, produced using a known algorithm, can be used to decode the data when one key (public key or private key) is used to encrypt the data. While private keys are kept secret and are used for authentication and encryption, public keys are made available to the public and are crucial for identification. The typical asymmetric encryption algorithms used in blockchain today include RSA, ECC, and SM2. Digital contract: An event-driven computer program called a "smart-contract" is used to automate transactions [13]. With the use of a smart contract, it is possible to automatically trigger payments, making the workflow of transactions easy for users to use, frictionless, and less prone to mistakes. Because smart contracts are governed by them, using them can not only lower administration costs but also prevent pointless disagreements. It is possible to conduct every transaction correctly. Distributed data storage: Each full node on the blockchain network has the same level of hierarchy and operates independently. On the local space, they keep and store their own copies of the shared ledger. Numerous issues with centralized systems can be solved with this kind of decentralized storage. It is utilized extensively in the blockchain industry since it can increase the system's dependability, availability, and access effectiveness [14].

2.3 Key characteristics of blockchain

The following characteristics of blockchain, to put it succinctly, are quite intriguing and make the technology appealing to education. Decentralization: The blockchain lacks a central node or controlling body [15]. Every node has the same responsibility and rights. All nodes work together to maintain the entire chain. Without the need for identification by the central administrator, transactions can be carried out between any two participants in the blockchain network. Transparency: The blockchain's transactions were governed by reliable mathematical algorithms. The policies and practices are clear and straightforward. Except for the encrypted private information, the majority of the data kept on the blockchain are fully permissionless and transparent [16]. Additionally, the data is saved in many copies across the entire network's nodes. Through the block header's hash value, anyone can view the data. The data cannot easily be concealed, making the system as a whole very transparent. Traceability and auditability: Each ledger transaction has a timestamp and is verified by a verified hash reference. As a result, it is simple to trace and track the transactions back to their prior ones. It is simple to track transactions all the way back to their inception thanks to the blockchain's audit trail. Security: Through the use of the following three techniques, blockchain offers strong information security. To ensure the consensus of the data, high redundancy storage is first deployed. The majority of nodes must agree before the update of any nodes is permitted. Second, the data are verified using the encryption algorithm to make sure they cannot be easily changed. Finally, the access privileges are managed using the multi-private keys. While maintaining the blockchain's transparency and traceability, users' privacy can be preserved [17].

3. Recent Blockchain Applications in Education

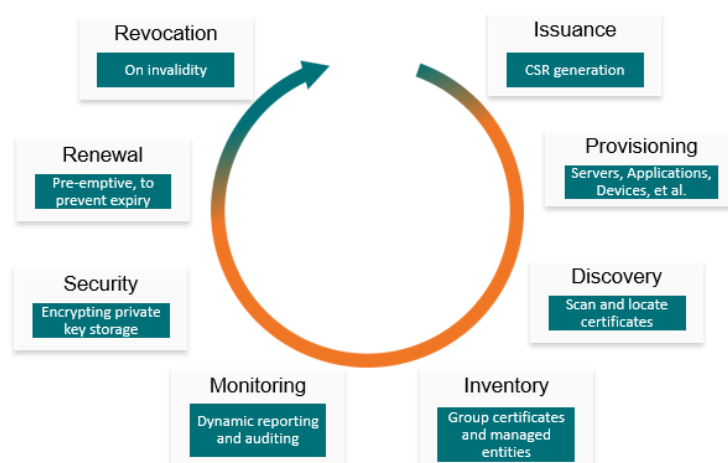
3.1 Learning to Keep Records

Historically, educational institutions have had sole custody and legal power over student learning records. This makes accessing and verifying the "official" data rather difficult for an employer or other interested third receiver. Additionally, "official" data typically just includes the letter grades, GPA, truncated course title, and course number (grade point average) [18]. It is unlikely that future employers will be aware of the student's activities while enrolled in the course. The decision-making process is the only one for which the official data are helpful. Blockchain opens us novel possibilities for the storage of student learning records. The actual work that students have completed in a lab or a service-learning project, as well as the As and Bs along with the course titles, can be kept in the students' records using the blockchain's built-in smart contract mechanism. Employers can view job seekers more thoroughly and so make better decisions [19]. Blockchain-based learning was a revolutionary idea put up by Devine. Teachers used the learning outcomes as virtual money that could be put into blocks and entered into a blockchain. The complete learning history was then accessible to everyone, including prospective employers. In her presentation, Farah laid out a system for tracking students' progress in their multi-learning tasks. Students had the option of choosing one or more repositories to keep their information [20]. The distributed recordings can be obtained and combined from various sources to promote reflective learning across platforms and personal development. This learning block therefore contained all metadata for a variety of activities. Ocheja suggested using blockchain technology to link learning data across institutions and businesses. The learning data was then managed and kept with consistency, usability, immutability, security, and privacy. With the use of blockchain, distributed storage, and cryptographic algorithms, EduRSS was able to store and share student records securely between institutions. Daragh unveiled UniChain, a platform for managing electronic academic records (EARs). the use of blockchain's standard technology, including timed-based smart

contracts and encryption methods. According to the early experimental findings, UniChain was highly effective at managing a large dataset with little delay. Blockchain technology was viewed as the best option in almost all application instances as a promising tool to secure, share, and verify learning records. With the learning record stored, the blockchain may be developed to assess the students' professional aptitude, making it much easier to find work and hire employees. There was a student ability evaluation system's design plan. The academic standing and accomplishments of the pupils, which were recorded on the blockchain, were clustered using the K-means algorithm. It was possible to evaluate the student's professional aptitude objectively, which will help the student find a job. Wu researched a skill evaluation methodology based on blockchain technology and used it to gauge the students' specialized knowledge and experience. By replicating the teacher and student scenarios in an operational skill competition, the viability was examined. There was a significant simplification of the evaluation procedure, and great effectiveness was attained. As a learning tool, Duan created an automated assessment program based on blockchain. The block contains a record of all learning outcomes, including process and proof, the indicator of the graduation requirement, the course name, and the course weight. As a result, the evaluation can be carried out in accordance with the index of university graduation requirements.

3.2 Issuing Certificates And Managing Them

Certificates are frequently used to demonstrate that a student has behaved well at school and adhered to all rules. The students receive a variety of awards throughout their time in school, including academic certificates, report cards, student certificates, reward certificates, certificates for English proficiency, professional qualification certificates, etc. It has been amply demonstrated that the security, transparency, and immutability attributes of the blockchain could be advantageous for the process of creating and administering certificates. Students now have easy access to all types of credential information from any location, thanks to technology. Additionally, blockchain technology enables educational institutions to safely and effectively handle the academic diplomas of their students. Finally, to effectively address the issue of authentication and improve trust, the certificate information saved on the blockchain will also be permanently maintained in the cloud server. The information submitted by students can be directly verified by prospective employers. A growing number of blockchain applications have been suggested in recent years to solve this issue. The MIT Media Lab started providing digital certificates for students in a community in 2015 using the blockchain-based Blockcerts system. More authority for their own certificates rests with the recipients. In that case, no third party verification procedure is required. The University of Nicosia, another pioneer in blockchain education, completely decentralized the issuance and verification of digital certificates. In addition to the traditional physical diploma, each graduate also received a PDF copy of the degree on blockchain. Similar to this, a permissioned blockchain-based infrastructure was suggested for decentralized academic credentials verification. The digital academic certificates' compact data proofs were stored using blockchain ledger technology. For the benefit of interested third-party intermediaries and education stakeholders, all the credentials were protected using blockchain's built-in security features. In addition to offering a distributed and interoperable architecture model, EduCTX, a credit platform developed from the open-source Ark Blockchain Platform, processed, managed, and controlled the credits (referred to as ECTX tokens) that students earned for passing courses. HEIs (higher education institutions) received access to more recent student data independent of the students' educational backgrounds, and students were given access to a transparent and unified perspective of their finished course.



Source: App ViewX

Figure 1. SSL Certificate Management

3.3 Ecosystem For Decentralized Education

Blockchain is a decentralized network without a centralized power structure. Each participant has the authority to confirm chain updates, and every stakeholder has access to the complete ledger. All stakeholders, including students, teachers, and authorities, may work together in a collaborative environment thanks to the feature. The method has advantages for all stakeholders. Decentralization is a quality that, in the opinion of educational institutions, enhances the management effectiveness of schools. Sony Global Education revealed plans to offer services for international education outside of the conventional framework. It made education more equitable, reduced the amount of time education administration departments intervened in the evaluation of the learning process and results, and considerably increased the effectiveness of education management. Bore unveiled a cutting-edge blockchain applicant case for the School Information Hub (SIH). Data regarding Kenyan schools was gathered, verified, and managed using a blockchain-based system. It would be simple for the decision-makers to understand the student level and what was going on at a school as a result. As a result, wiser choices may be made and more effective solutions can be developed. The use of blockchain in education can be very advantageous. For instance, efficient teacher-student communication is essential for online learning. To promote efficient communication between professors and students, a cutting-edge interactive multimedia system was offered. On the other hand, blockchain and its decentralized topology encouraged the data exchange. The authors felt that the use of this technology would allow for the high efficiency, security, and privacy of interactions between teachers and students. Zhong suggested a creative use of the idea in e-learning. The method they designed can provide an additional reward in the form of virtual currency to the top-ranked students in accordance with the incentive policies implemented on the blockchain network. The learning engagement was said to have enhanced with this solution. In the aforementioned system put forth by Duan, the evaluation of students' performance in college can be transformed into the evaluation of their

post-job competencies, and the evaluation of their student competencies can also be projected into the teaching evaluation of each curriculum, aiding in the continuous improvement of the curriculum.

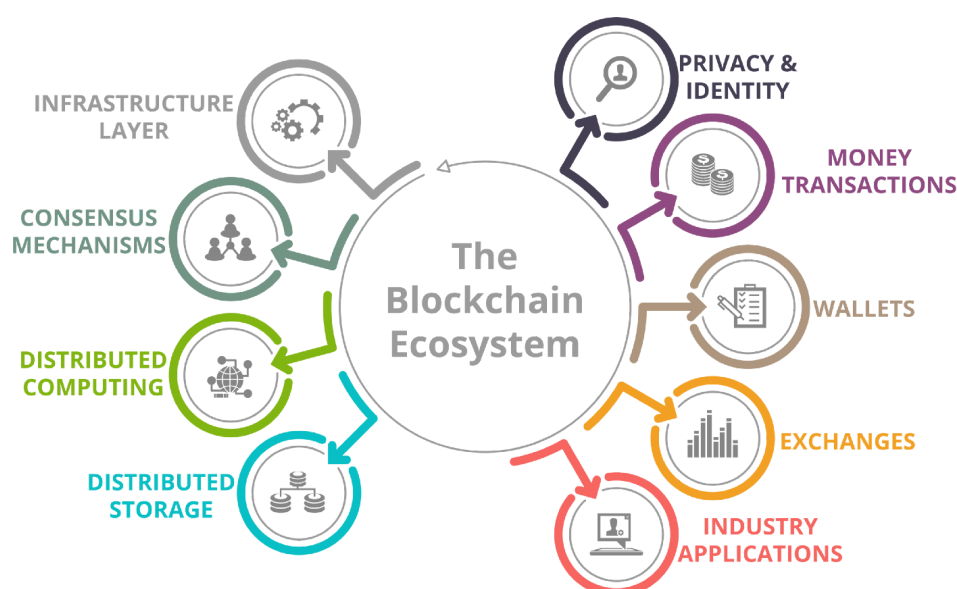


Figure 2. The Blockchain Ecosystem

4. Blockchain Issues and Challenges in Education

Despite the high likelihood that blockchain technology will disrupt the educational system, it is currently in its experimental stages and must overcome a number of obstacles. Some of them are caused by nascent technology, while others are caused by non-technological factors.

4.1 Technical Difficulties

First of all, scalability is one of the major issues discussed in a lot of literature. A greater proportion of blockchain nodes results in a greater need for storage and slower network transmission. All parties must save transaction records and accompanying data in order to use the synchronous storage technique. It requires mass storage systems from the consumers. The efficiency of the consensus process and the nodes' response times, meanwhile, both drastically decline as the number of blockchain nodes rises. The second challenge that blockchain education must solve is security. Despite the intrinsic security that the blockchain can offer, both internal and external dangers still exist. Theoretically, data information may only be released or altered when more than 51% of nodes are simultaneously attacked and under the control of hackers. However, it is difficult to ensure that the method won't be broken in the future, leading to the disclosure of teachers' and students' information given the progress of mathematics, cryptography, and computing technology. Additionally, all transactions are clear and open, and any information is accessible. The security of instructors' and kids' privacy is thus compromised since some inferences can be drawn or the state and conduct of students and teachers can be predicted.

4.2 Non-technical variables

1. A major lack of qualified blockchain engineers and specialists exists. The demand for blockchain human resources has been rising recently as a result of the promotion and use of blockchain across numerous industries. For the purpose of creating a blockchain-based system, both startups and established businesses who want to keep up with the times are looking for engineers. However, a top-tier R & D team is required to create a secure and trustworthy blockchain education system with complete functionality and high usability. A major issue for practitioners and academics in the field of education is the requirement that members have strong technological and mathematical backgrounds. Learners, educators, and other professional parties in the chain struggle to understand blockchain technology, platforms, and smart contracts. Tossing the development task up to computer experts seems like a solution. Unfortunately, the systems created by computer engineers frequently fall short of meeting the needs of students.
2. The majority of blockchain research is now being done with the goal of upending the old financial sector, while applications in education are still in their infancy. The absence of practical experience and policy protection present difficulties for future development. The decentralization will significantly affect traditional educational institutions in the first place because there is a lack of policy protection and direction. A negative attitude against the new applications was developed by key institutions and departments as a result of the significant losses experienced by the traditional education platform. Second, because there are so few application cases, experts and academics are waiting to see what happens rather than pushing for more applications.
3. The data on the blockchain is spread, recorded and preserved due to decentralization, which muddles the ownership rights of student data. Currently, data management is often handled by the school affairs office. Due to the implementation of blockchain, all data was saved on the network, which reduced the role of the entity administration department. Then, fresh issues emerge. Whose virtual data is it anyway? Who is the owner of the use rights? Who is the owner of the outcomes of the data analysis? For the continued use of blockchain in education, a number of concerns resulting from data property rights need to be researched and addressed.

5. Conclusion

Blockchain technology has been developed and put to use, which has led to new technical foundations and useful models for educational and teaching reform. The application, ownership, and privacy protection of students' learning data, for example, as well as other issues and challenges remain, but there is no denying that everyone, from traditional primary and secondary schools to universities and educational administrative institutions, and then to business enterprises engaged in the education and training industry, has realized the potential of blockchain technology. As a result, they have committed resources like money, technology, and expertise to researching the blockchain revolution in education. The use of blockchain in education is still in its infancy at the moment. The application's scope is likewise extremely constrained, with a primary focus on learning record administration, certificate issuance and maintenance, and the development of a decentralized educational ecosystem. When it comes to the influence and changes, it is anticipated that educational institutions, teachers, educational researchers, and students will be open-minded and positive. As such, they will have made the necessary preparations for the extensive and in-depth deployment of blockchain technology.

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