Blockchain Technology Adoption in Education: Uses and Difficulties

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Abstract

Beyond Bitcoin, there are other uses for blockchain technology. Numerous businesses, including healthcare, education, banking, and insurance, might make use of this technology. This article describes the potential applications of blockchain technology in educational settings in addition to offering a general overview of the technology. Educational records management includes things like verifying and transferring student degrees, transcripts, test results, and records - including those pertaining to college admissions as well as educator credentialing, certification, and re-certification, managing and monitoring school property like buses and library books, and managing student privacy and parental permissions.

Keywords: Blockchain, Bitcoin, Education, Uses, Difficulties

Introduction

The concepts of blockchain were first introduced in 2008 by a person going by the pseudonym Satoshi Nakamoto, who also explained the operation of an open distributed system and cryptography. At their foundation, distributed and decentralized programs are present in all blockchains. Imagine blockchains as a decentralized, immutable database that records each transaction ever made and distributes that data to everybody concerned [1]. The initial blockchain implementation was based on the Bitcoin protocol. Blocks and transactions are kept track of via an encrypted distributed ledger. Transactions can be divided into two categories: incomplete transactions and finished transactions that haven't been included to the main chain's blocks yet. First, a root block is made. A group of transactions that will be appended to the distributed ledger with the appropriate time stamp are contained in each block. New transactions are validated and added to the main chain through mining, which is a highly competitive and labor-intensive computer process that forms new blocks[2]. In Bitcoin transactions, blocks can be classified as orphan blocks, main chain blocks holding encrypted confirmed transactions, and main chain related blocks

that exclude (not associated with blocks from the main chain) blocks. The first two categories are represented in a directed rooted tree with ties to the root (via a preceding pointer), except for the orphan blocks. The blockchain, which is a back-linked list of transactions created from hash pointers from a technological standpoint, is ultimately reached through the rooted tree [4]. Each block is uniquely recognized by its cryptographic signature. An infrastructure of private and public keys is maintained by the blockchain network. Although blockchain technology has several applications in a wide range of industries, this article will concentrate on potential usage in the education sector. This technology will aid in the construction of a secure and transparent system for tracking and validating academic records. Through the establishment of a decentralized system for exchanging study guides, classes, notes, etc., it helps to improve access to educational resources. It will help reduce the problem of data breaches by helping to build a mechanism for transferring student data that has better security. It is applicable to the creation and issuance of digital credentials that are secure, non-fragile, and verifiable. Furthermore, this technology will facilitate the creation of a scheduling and course registration system that is more efficient. And making it simple for teachers to oversee the courses they offer.

Ecosystem of Blockchain

The following could be a part of an education-related blockchain ecosystem:

1. **Educational Institutions:** These can be colleges, universities, or other establishments that provide courses and other forms of instruction.
2. **Students:** People who are registered in courses and programs provided by educational institutions.
3. **Teachers and Educators:** Are those who are in charge of imparting knowledge to students and offering them advice.
4. **Digital platforms** called learning management systems (LMSs) make it easier to distribute educational materials and encourage interaction and cooperation between educators, instructors, and students.
5. **Providers of Educational Content:** These are companies or people who produce and offer instructional resources like films, books, and other stuff.
6. **Organizations for Assessment and Accreditation:** These are the ones in charge of assessing the caliber of educational programs and granting accreditation to colleges and universities that satisfy specified requirements.
7. **Employers:** These are businesses that take on people who have finished schooling and possess the abilities and expertise required for a certain position.

8. **Government Agencies:** These are organizations that regulate and oversee the education sector, such as the University Grant Commission, Ministry of Education.
9. **Professional Associations:** These are groups, like the All-India Council for Technical Education and the Indian Medical Association, that serve to promote and advocate for professionals in certain fields.

Potential of Blockchain in Different Fields

The two primary benefits of utilizing blockchain in education are data security and protection—even in the event of a compromised node. The education sector reacted swiftly to digitization during the pandemic [3]. Blockchain technology has the power to completely transform the educational landscape. First and foremost, blockchain has the potential to drastically change how educators and students work together and manage scholarly data [5]. The distributed ledger technology of blockchain has the potential to significantly improve the accountability and transparency of the education industry [3].Let's look into the potential effects of blockchain on schooling. With everyone become more tech-savvy by the day, disruptions in the education sector are inevitable. Over the years, the EdTech industry has helped us. This pattern has contributed to the advancement of educational modernization. Today is the moment when blockchain technology greatly quickens the procedure. Textbooks are gradually being replaced by machine learning, artificial intelligence (AI), and distributed ledger technologies like blockchain.

An analysis (2019) states that blockchain start-ups are growing in popularity across a range of industries, such as supply chain management, banking, healthcare, and agriculture. The bulk of start-ups are in the financial industry as blockchain technology was first created as the basis for the digital currency Bitcoin. In order to track and verify transactions, the financial industry requires a more transparent and safe structure. The financial industry is the only one with the cash and resources required to develop this technology, which is the other reason. The remaining startups are dispersed over several sectors, including real estate, energy, healthcare, education, and transportation.

Impact of Blockchain Technology in the Education Sector

Blockchain technology has the potential to completely transform the education industry in a number of ways.

A. **Intelligent Contracts for Tasks and Classes:** Smart contracts are widely used in blockchains. This can assist educators in developing blockchain-based curricula. The course will automatically start when the prerequisites

are satisfied and can proceed at its own speed [6]. Teachers and students can both sign asmart contract that specifies an assignment's parameters, including the date of submission and the marking deadline.

B. Veracity of Documents and Degrees: Blockchain's immutable ledger technology creates a timeline of recent occurrences. This can be helpful for keeping track of attendance, giving out thorough report cards, and updating stakeholders and students on their development [4,5, 6]. Students are able to turn in their assignments. utilizing blockchain without worrying about losing them, and the originality of their work will be preserved. Furthermore, instead of receiving their degrees and certificates on brittle paper, students can now obtain them online. Digital degrees and certificates provide several benefits, such as ease of use, organization, speed, and low workload.

C. Education Incentivization: Tokenization and crypto currency are two of the most important application cases for blockchain technology. In the near future, instructors will be able to reward students with coins if they succeed or finish a specific major [6]. Furthermore, the teaching-learning, the gamifications component of the tokenization teaching approach has the potential to permanently change the process [4]. Rewarding students for high exam performance or on-time work submission serves as a powerful incentive for them to achieve high marks and turn in their assignments on time.

D. Grant Access: Blockchain technology can facilitate access to publicly available, freely utilized and distributable educational resources including books, courses, and notes in addition to encouraging lifelong learning [5]. The materials can be affordably and securely distributed to the general population. With the help of this technology, students who live in remote areas of the world can participate in classes and exams electronically. Teachers can use this technology to grade their students directly on the blockchain, which is extremely beneficial.

E. Streamlining Fees Payment: For students, paying their tuition is a challenging and time-consuming process. However, as block chain technology creates a decentralized record for payments, it will be helpful in expediting this process, leading to decreased administrative costs and possibly even lower tuition rates [4]. This ledger can lower operating expenses and strengthen ties between two entities together by accelerating the real-time transaction procedure.

F. Identity and Student Records: Secure handling of any data related to a student enrolled in a course of study [4,5]. The primary goals of innovative education will be to identify patterns in learning and improve training, both of which contribute to the development of new learning models. The ledger may contain information about specific courses as well as a graph of learning exchanges.

Challenges of Adopting Blockchain Technology in Education

The use of blockchain technology in the education sector is fraught with difficulties.

1. A rise in transaction volume impacts scalability since it raises block sizes, which in turn raises transaction latency [7, 9].
2. Adopting the technology comes at a very hefty cost. The costs associated with employing this technology, such as the cost of processing power, the cost of upgrading the existing infrastructure, the cost of managing enormous volumes of data, etc. [7,8,11].
3. The blockchain still has issues with poor usability, complex settings, and poor data management, which will make educational institutions hesitant to put their data on it. [10,11].
4. Mutability will be troublesome because immutability can make it difficult for organizations to put new rules about information storage into place.
5. There is also an issue with latency and complexity as blockchain uses hashing which is very complex and requires a great deal of computational power to crack making it a very long and time-consuming process [10].
6. The need to modify the current infrastructure in order to adopt blockchain technology and the fact that most people won't be able to utilize it even once they do are also huge obstacles to its adoption and awareness.
7. Due to a lack of regulation and stringent legislation, user security and privacy are a challenge, which could result in an uptick in criminal activity and a higher risk of scams due to the proliferation of fraudulent blockchain projects [7,10,11].

Literature Review

1. Pratima Sharma and colleagues' work [6] provides an organized and comprehensive summary of the state-of-the-art smart contract applications. Describe the challenges that smart contracts built on blockchain face. Parameters: It gives a summary of applications that enable smart contracts. The use of smart contracts is growing quickly,

however there are still several issues that need to be resolved, like Identifying and it is imperative that these vulnerabilities be fixed in order to construct smart contracts. The best practices for creating durable and safe smart contract apps will be outlined in this study.

2. The paper [11] provides a comprehensive analysis of the application of blockchain technology in network ideological and political education at universities. It also includes a useful debate on the creation of application scenarios. Performance Measures: This paper describes how to establish the basic framework for the application scenario model. that is to combine the blockchain technology platform with the network conceptual practice taught in colleges and institutions.
3. In the paper [1], Satoshi Nakamoto provides a thorough description of a peer-to-peer network as a remedy for the double-spending problem. Transactions are timestamped by hashing them into a continuing chain of proof-of-work. Messages are disseminated utilizing the best efforts of the nodes, which are free to join and exit the network at any time. Performance Measures: a network of peers that use proof-of-work to keep a record of all transactions for the public. The network is strong and safe because of its unstructured simplicity. Nodes are allowed to join and exit the network whenever they choose, acknowledging that the chain serves as proof of events that happened while they were away. Very little structure is required for the network itself.
4. In this research paper [10], Wei Cai and colleagues present an outline of the development of blockchain systems to illustrate the importance of decentralized applications (dApps) and the potential benefits of blockchain technology. the most current dApps and talk about how blockchain development will evolve in the future to achieve the desired dApp attributes. Performance Measures: Blockchain-based systems employ P2P networking, cryptography, and consensus mechanisms to build the framework for decentralized applications. We have examined the evolution of blockchain technology and explained its jargon in this article.
5. The article [3], in which. Victoria L. Lemieux provides an explanation of how distributed ledger technology and blockchain ensure reliable and unchangeable data in a variety of records management use cases, such as healthcare and real estate. Performance Measures: It advances the creation of a practical framework for assessing record-keeping based on blockchain technology. Systems that make the promise to offer reliable, unchangeable records. Comprehending the shortcomings can facilitate the creation of enhancements that tackle deficiencies in this inventive new series of technologies.

Case Studies

There are few case studies where the blockchain technology is used:

1. The Massachusetts Institute of Technology (MIT) is among the early adopters of blockchain technology in education. MIT established the MIT Bitcoin Project in 2015 to investigate the possible applications of blockchain technology in education, including creating open, safe systems for tracking and validating academic records.
2. The University of Melbourne has put in place a blockchain-based system allowing digital credentials, like degrees and certificates, to be issued and verified. The institution has also developed a blockchain platform for the exchange and distribution of course materials, such as publications and lectures.
3. A blockchain-based system has been put in place at Peking University in China to store and manage academic records like transcripts and marks. The institution also created "red envelopes," a virtual money that members of the campus community can access, using blockchain technology.

Conclusion

This article included an overview of blockchain technology and details on how to use it in education. One benefit of utilizing this technology is that it provides an open and secure record-keeping system, which helps to guarantee the legitimacy of the credentials. There is increased security and privacy for the student data. The dearth of awareness and comprehension of the blockchain, the exorbitant price of Along with the advantages of installing and utilizing this technology are regulatory and legal problems.

Potential study areas include the creation of a more user-friendly and intuitive platform to encourage wider use and integration with other technologies like artificial intelligence and the internet of things. The application of blockchain technology in education will be extremely beneficial to future generations and the challenges that need to be handled.

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