Blockchain Technology And Its Applications Towards Sustainable Development In The Educational Sector

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Abstract: Blockchain technology has permeated the economy and it has been found to be a useful tool in digital innovations in the finance industry in achieving lower transaction cost, making intellectual property ownership and payments more transparent, automated and seamless. It is also found to be helpful in the Government sector due to its unalterable ability of any digital asset and information security through the use of end-to-end encryption. In line with these benefits of Blockchain, this paper aims at exploring the Blockchain technology and its applications towards sustainable development in the educational sector through qualitative studies and analysis. It is found that Blockchain technology has now progressed far beyond the above-mentioned usefulness and has become a new way of solving problems in the areas of records maintenance, verification, tracking and aggregation of information. This will be of great value in the education sector due to its ability of data storage, which is securely encrypted on a Blockchain network and will significantly reduce risks and information sharing. Blockchain technology in the educational sector will eliminate many challenges such as unsecured system, manual filing of documents which takes up time and often cause duplication of information, inaccurate sharing of information, vulnerability to identity mismanagement and theft. It will also make data highly available in real time than a centralized database and cuts down cost of building infrastructures for data hosting. This paper fills literature gap by presenting a comprehensive review on blockchain technology and the various ways through which it will help in providing sustainability in the educational sector.

Keywords: *Blockchain, Educational Sector, Sustainable Development.*

1. INTRODUCTION

With the rapid increase in knowledge and usage of the blockchain technology, there has been lots of researches carried out to harness the usefulness of this technology. For most people, the blockchain technology is still a mystery, it's yet to be understood and most people don't use it [1]. A lot too equates Blockchain to Bitcoin, which has made it a lot worse to be misunderstood. The application of blockchain has never been fully known to an average user, while in the case of cryptocurrencies, they seem risky or even dangerous. However, blockchain has its applications in the educational sectors, healthcare sectors, banks by abolishing ATM and introducing blockchain bank, Internet of things, transparency in elections, as a means of payments, transforming renewable energy in Africa, etc.

Blockchain is a Distributed Ledger Technology (DLT), which helps the user to keep records of any digital transactions, and makes the history of any digital asset unalterable and transparent. It exists as a distributed database that maintains a continuously growing list of ordered records, which makes the previous records of any digital asset unalterable and transparent through the use of decentralization and cryptographic hashing [2]. It is a distributed digital ledger in the sense that the blockchain is nothing but a registry of transactions or information of various sorts, which is registered online in a network. It exists as a distributed database, which means there is no authority and every participant is a point of authority and they are all equal in nature. The data is distributed instead of copied or

transferred [3]. It eliminates the need for intermediary, which reduces costs and it is economically unviable to hack.

Blockchain in a big way can be a vital tool to boost sustainability [4] in the various sectors it is being applied to, such as in the supply chain industries and other economic sectors, digital innovations in the finance industry, transparency and effectiveness in government sector, and in records maintenance, verifying, tracking and aggregating of information.

This research is aimed at exploring the unique features of the blockchain technology as it concerns the education sectors in terms of records maintenance, information aggregating, and providing information on real time bases.

2. BACKGROUND OF STUDY

The concept of blockchain came into existence as a core component for the invention of the digital currency Bitcoin, by Satoshi Nakamoto in 2008. "Blockchain started as a way to move bitcoin from point A to point B but it is now being used by a host of big companies to monitor and move any number of Assets around the world as easily as sending an email," said Michael del Castillo, Associate Editor, Forbes [5].

According to a survey ran by Gartner 2019 CIO, it revealed that 2% of higher education respondents have already deployed Blockchain. Another 18% of respondents were planning to do so within the next 24 months.

Nearly half of respondents, about 47%, indicated lack of interest. Many disinterested groups are taking the wait-and-see approach, considering the extreme hype, immaturity and potential risks of blockchain. On the other hand, others are unaware of the potential benefits [6].

Basically, a blockchain is a distributed database, which maintains a continuously growing list of ordered transaction records, called blocks. Every block contains the data stored and a link to the previous block. This makes it an open ledger like an open-source code that captures transaction data between parties at every stage in a permanent and verifiable way [6].

As blockchain is clearly defined as a distributed system, we need to understand the different types of systems, its pros and cons and why the distributed systems are the best. Systems as we know it are relevant worldwide. Before we go ahead let us understand the concept of Authority.

Authority can be defined as a person or organization having power or control in a particular sphere. It is good to note that the sectors of authorities are what differentiates the three systems from one another.

The three types of systems we have are

a. Centralized systems

It has a single authority meaning all processes are carried out at a single location.

Benefits: It is easy to implement and co-ordinate and decision making is easy. The economies of scale reduce duplication of work which is seen sometimes with multiple authorities because you have just one single authority.

Disadvantages: The system can collapse if the central authority fails in securing it. It is bureaucratic in nature meaning there is no transparency and it is prone to fraud.

Examples of those operating in this system are: Banking system, food franchise, Server CPU, etc.

b. Decentralized system

For a Decentralized system, it has multiple points of authorities. It enables us to store assets in a network that can be accessed over the internet. It is less susceptible to collapses. It has a flatter hierarchy compared to centralized systems.

Benefits: Decisions made closer to customers, i.e. authorities have more information about the end users of either the product or service rendered. Taking down one point of authority will not affect the others unlike centralized systems. The owners have direct control of them via their private key, which is directly linked to the assets

Disadvantages: Diseconomies of scale now with multiple authority there may be duplication of task problem. It is not completely secure; they are still susceptible to collapses.

Examples of those operating in this system are banks, or a multinational company in the network, government and cloud database.

c. Distributed system

For a Distributed system, there is no authority rather everyone is an authority. They are virtually unsusceptible to collapses. It doesn't mean the system cannot be hacked. However, to bring down a system, one must control or alter more than 50% of the points of authority. The cost of doing this itself will erase most gains and this will make it economically unviable to hack these systems. It has completely flat hierarchy. Every participant in this system is a point of authority. Everyone is equal to everyone.

Benefits: It removes the intermediaries and thereby reduces costs. It is economically unviable to hack and breakdown, which makes it extremely safe. It is completely transparent. The chance of someone committing fraud is highly unlikely and very difficult.

Disadvantages: It is still a nascent technology, for the fact it is still new it will still take a lot of time to stabilize. They require massive initial capital investment to set up.

Examples are cryptocurrency and blockchain networks.

Note: The current way of keeping records of student and staff information, certificates, diplomas, awards, etc in our school system is still based on centralized and decentralized systems and I have clearly explained the pros and cons. The Internet transformed our lives by decentralizing the access and flow of information. The next phase has now begun! Blockchain technology has caused a paradigm shift making processes more democratic, secure, transparent and efficient.

3. METHODOLOGY

**Architecture Of A Blockchain**

Blockchain can be defined as a chain of blocks that contains information. The data, which is stored inside a block, depends on the type of blockchain. The real purpose of blockchain is to address the problems of double records without need of a central server.
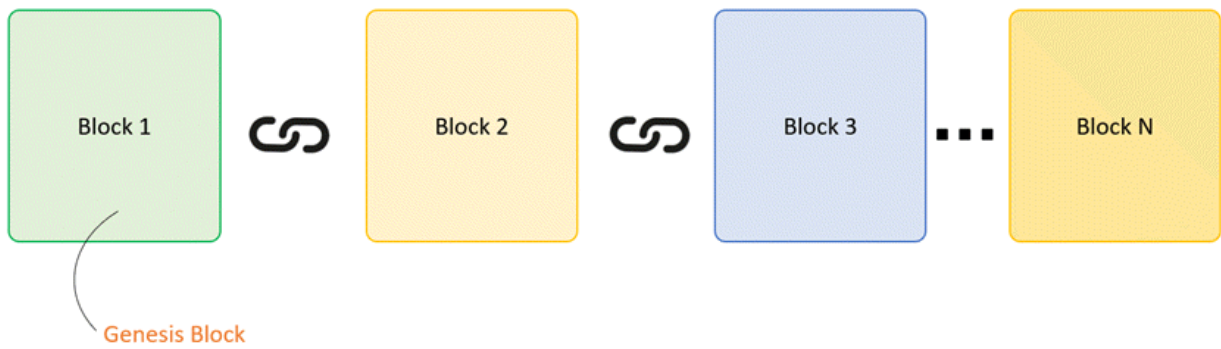
Block

A block comprises components such as Data, Hash and Hash of the previous block. The first block in the chain is called the Genesis block while each new block in the chain is linked to the previous block by some elements called the hash.
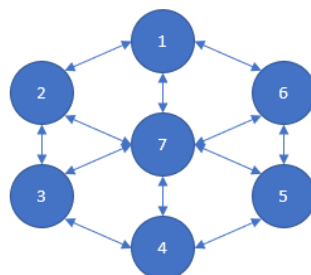
Hash
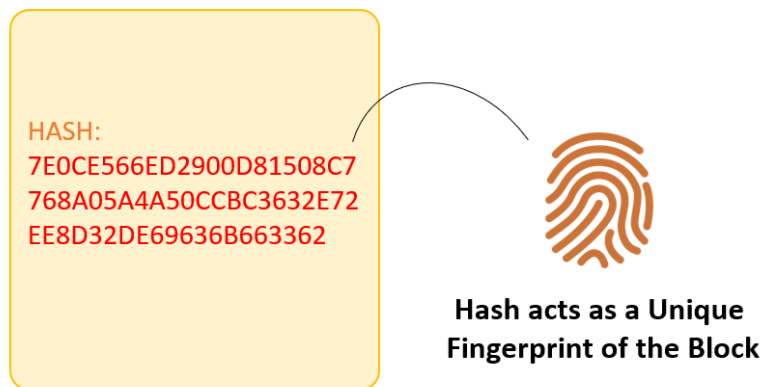
A hash is a 256-bit cryptographically unique value calculated on the contents of the block. A hash can also be found in a block as started earlier. It can be understood as a fingerprint, which is unique to each block. Therefore, once a block is created, a hash is generated and any change inside the block will cause the hash to change and therefore it does not remain the same block.

Nodes

Nodes can be any type of electronic device that maintains copies of the blockchain and keeps the network functioning. The nodes check transactions and group them into blocks. Without nodes, a blockchain's data would not be accessible. They store, spread and preserve the blockchain data, so theoretically a blockchain exists **on** nodes.

Miners

Miners create new blocks on the chain and the process is called mining. To add a block, it is necessary to undermine it. A special software is developed and used by the miners to find a nonce that generates an accepted hash. which requires solving a unique mathematical problem of great difficulty that consumes some very considerable computing resources. This makes mining a block difficult especially on large chains. When the right nonce has been found they term it the "golden nonce" and their block is added to the chain. Therefore, making a change to any block requires re-mining not just the block to be changed but all of the blocks that come after it. That is why it is extremely difficult to manipulate blockchain technology since it requires enormous amount of time and computing power.

The Working Principles Of Blockchain

First Step: A person requests a transaction. The transaction can vary from cryptocurrency, records, contracts, etc.

Second Step: The requested transaction is broadcasted to a distributed network with the help of the nodes.

Third Step: The network of nodes validates the transaction and the user's status with the help of known algorithms.

Fourth Step: At the point the transaction is completed the new block is then added to the existing blockchain.

NB: Once the block is added it is permanent and unalterable.

Why A Blockchain Cannot Be Manipulated

Consider the following example, assuming we have a chain of 3 blocks. The 1st block has no predecessor; hence it does not contain the Hash of the previous block. Block 2 on the other hand contains a Hash of block 1 likewise block 3 contains the Hash of block2.
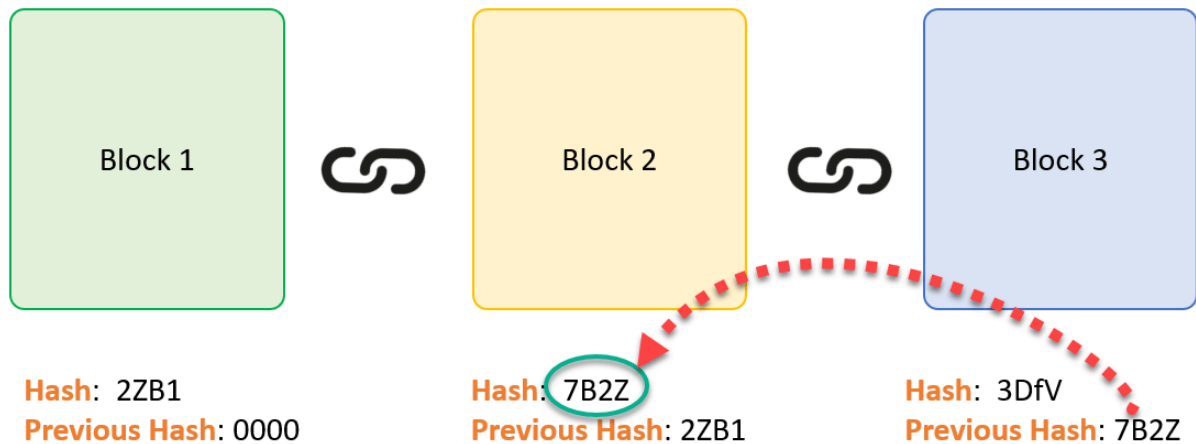
Assuming an attacker successfully changes the data present in Block 2. The Hash of the Block also changes, but Block 3 still contains the old Hash of the Block 2. This makes Block 3 and all succeeding blocks invalid, as they do not have correct hash of the previous block.

4. BLOCKCHAIN TECHNOLOGY AND ITS APPLICATIONS

Why Do We Need Blockchain?

The major benefits of blockchain technology are numerous and not limited to the ones being discussed shortly

Transparency and Immutability

Every party in the network is a point of authority and any added data or transactions is seen and verified by all, providing maximum transparency. The immutability of data makes it even trustworthier as well. Once data is created on a block and transaction completed, it can't be deleted or altered.

Process integrity and disintermediation

There is high regard for integrity such that the parties in any transaction will be aware that everything agreed on will hold exactly as they said. The trustworthiness between the party eliminates the need for intermediation by a third party.

Lower costs and faster transaction

Blockchain is very great at cutting down overall transaction costs and time by discharging the need for a third-party intermediary in exchanging assets. For example, in the sale of real estate and intellectual property, the transaction is peer-to-peer, seamless faster within seconds and trusted.

Access to high-Quality Data for everyone

Every participant in the network will get in real time the complete data, updated information of the transaction they need which is accurate, timely and consistent.

Security

Attacking a traditional database is the bringing down of a specific target. With the help of Distributed Ledger Technology, each party holds a copy of the original chain, so the system remains operative, event the large number of other nodes fall

5. CONCEPT OF SUSTAINABLE DEVELOPMENT

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [7] .

Most technologically inclined companies like IBM and Microsoft are investing in infrastructures to support blockchain, it would be a lot easier for companies and business to move in that direction. Blockchain as we know it can change the way business transactions take place. The visibility in its process, which help ensure efficient transactions, promoting food safety, efficient records, elimination of counterfeits and trust between ethical trading partners.

Blockchain Technology And Its Sustainability In The Educational Sector

Blockchain's sustainability in the educational sector, can be seen to the fact that it transforms student's record keeping of degrees, certificates and diplomas into digital records. It does that by creating virtual series of blocks linked together, and despite the failure of a node or two the documents remain intact hence the need for the sustainability. None can be altered by a party hence its immutability and the records are traceable to the origin of the chain.

"The most promising use case of Blockchain in higher education are:

1. **To transform the students record keeping and credentials** e.g: degrees, certificates and diplomas: school administrators can manage and consolidate student's information. The digital trial found in the blockchain technology allows the information to be kept secure and unalterable. It also allows for additional enrolment to be added by creating new blocks linked to the previous ones. It will increase the ease of accessing the accurate information by companies in the future for job applications.

2. **Innovation learning platform**: with the advent of blockchain technology, online learning for higher education is more embraced. It also allows students the liberty to study for a particular specialization and field of study [8]. The data on the blockchain will show what related or compulsory courses the students need to take in order to qualify for whatever requirements that certification exam requires.

3. **Incentivizing students and teachers to achieve greater results:** Incentives such as free access to extra courses or earning crypto currencies when courses are completed in due time with excellent grades can encourage a higher rate of participation in schools.

4. **Introducing verifiable lifetime student transcripts:** Blockchain technology solves the problems of verification and accreditation. Before the internet when the manual method was in vogue, to verify a student's transcripts requires the company who needs this to contact the school administration and request the student's transcript. With the invention of blockchain technology, these transcripts would be part of the information kept electronically [8].

5. **Learning performance tracking and individualization**: The use of blockchain technology will give accurate learning performance and track your grades as you enroll in courses online. It makes teaching and learning more engaging and fun.

Some Companies Providing Blockchain Solutions To Educations

1. **Blockcerts** - is a platform created for storage and verification of digital certificates, diplomas, etc.

2. **APPII** - is a platform for CV builder, career experience verification and recruitment.

3. **Disciplina** - is a platform that uses blockchain technology to keep track of students' academic progress.

4. **ODEM** - is a decentralized marketplace for products and services in education

6. LIMITATIONS OF BLOCKCHAIN TECHNOLOGY IN EDUCATION

Slower transactions and scalability challenge: since educational systems have large data collected on so many students, which leads to increase in block sizes. These leads to scalability challenge and slow speed blockchain transactions because as the number of blocks becomes larger, transactions on the blockchain requires more time given that each transaction requires peer-to-peer varication [9]. These slow transactions might be an impediment when blockchain-in-education solutions are explored and adopted on a wider scale

Risk of error: since the data encrypted on a blockchain network is immutable and unalterable, any error make on any block cannot be overwritten and it requires the creation of a new block.

A vision for the future: it is hard to predict whether blockchain will have a long time sustainable impact in education. It was gathered that unless large multinationals and/or governments start to use and value digital credentials in the near future that in 5 years academic digital credentials may become extinct [9]

7. CONCLUSION

Blockchain technology has been seen to be of great value in the educational sector due to its ability in data storage, which is securely encrypted on a blockchain network and provides information on real time basis. It has also seen to be useful in improving the education system in the way of record transparency of both students and staff and effective maintenance to avoid duplication, accurate verification to avoid errors or alteration while retrieving information, tracking of past records and aggregation of information for final use, thereby ensuring sustainability in educational sector.

Based on findings of this study, the researcher recommends that educational sectors should adopt the blockchain technology (Distributed Ledger Technology) due to its numerous benefits such as its ability in data storage which is securely encrypted on a blockchain network and provides information on real time basis thereby ensuring record transparency and elimination of fraud and errors which leads to sustainability in educational system.

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