

## Blockchain Technology to Increase the Credibility of the Academic Credentials

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### Abstract

Blockchain technology as a decentralized ledger has capabilities to transparency, immutability and does not rely on third parties to control. In the past, the technology was applied only in cryptocurrencies such as Bitcoin and Ethereum. Currently, the technology is exploited to manage important data in various businesses that are not just financial. Some application such as education sector also requires the ability of the blockchain to generate the education certificate that can be confirmed the graduation for further studies at a higher level or job applications. In this article, have realized the validity of certificates through various researcher. Therefore, aims to find and combine research related to the use of blockchain technology to addresses problems in counterfeiting educational certificates to explain and compare to those who are interested. The research related was used of blockchain technology in many forms including permissioned and permissionless blockchain. Both of these are used to create a decentralized system that is different in each objective. Although, the benefits will be similar in the endpoint, in order to anti-counterfeit to create the credibility of the certificate. Based on this relevant research analysis, the author hopes to bring benefits in each system to develop their own technology in the future.

**Keywords** : Blockchain, Cryptocurrencies, Permissioned, Permissionless, Academic Credentials

### INTRODUCTION

The current blockchain is used not only for financial business but also extended to many businesses. Because of the great advantages of Blockchain technology is information transparency. While this document has been written, further studies in higher education or current job applications still require a graduation certificate or confirmation that this person has graduated from an institution that Issuing real documents. That case has not yet included the problem caused by the revision of the certificate to add value to the cheating person. By creating these counterfeiting educational certificates, it may take only a few minutes to do. But the investigator may take several days to be able to confirm that this document is true or sometimes impossible to verify at all. The inspection that takes place requires both manpower and costs. If looking at the news in the past several years, there will be damage to the use of fake certificates for fraud. Both with the government and the private sector. This problem also affects the country because workers who enter the work come from cheating and do not have enough knowledge and ability to actually push the economy to grow.

### RELATED WORKS

Recent developments in blockchain technology and distributed consensus systems has opened up new opportunities for creating ledger accounts that bring people who do not trust and do not know each other by without central authorization. The beginning came from the launch of Bitcoin. [1] Blockchains have been used as the main cryptocurrencies transfer mechanism. Soon became the growth of the Ethereum platform [2] which users begin to realize that using the blockchain and consensus rules is not only a matter of financial business.

In many research of the blockchain technology applied in higher education. They have referred to Bitcoin, Ethereum and other permissionless blockchains have mentioned

with important features that everyone can freely network and can monitor public transactions. Anywise, there are still many institutions that require permission blockchains solution that include Hyperledger [3], Tendermint [4], Ark [5], Kadena [6] that provides only a permissive ledger that has been allowed into the Blockchain system. And in addition to the details mentioned above, the consensus algorithms in research, it is still not the same. Consensus algorithms include proof of work (PoW), proof-of-stake (PoS), delegated proof-of-stake (proof-of-stake), proof-of-importance, proof-of-burn, proof-of-deposit, etc.

NazarÃ© et al [7] have proposed a platform that is used for creation, sharing resources and verify the digital educational certificates using the blockchain technology. This project is based on the Bitcoin blockchain that is presented by Media Lab Learning Initiative at the Massachusetts Institute of Technology (MIT). For achieving the propose of address the problem of academic digital certification, but the platform has not continued the possibility of using a blockchain to generate education grades for the student.

As well as the La Plata National University (UNLP) [8] and Argentinian College CESYT [9] have begun to develop their own blockchain for the issuance of certificates for their students. Which both use the solutions of blockchain technology and encryption Such as digital signatures, timestamps, etc. However, their methods have not yet been implemented in the credit received for complete academic success. This method still uses the bitcoin blockchain as well.

Bitcoin blockchain is still being used in the education industry. For example, since 2015 until 2016, the Holberton School in San Francisco [10], announced that it will use blockchain technology to help employers verify academic credentials. And, the Parisian Leonardo da Vinci Engineering School (ESILV) [11], in collaboration with the French Bitcoin startup Paymium, announced that it will issue a certificate using the bitcoin blockchain. However, there is still no more report on what kind of model will be made.

BlockCert is the one that joins in bitcoin network which uses advantages of the bitcoin block transaction structure to be intermediary for issuing and retrieving academic credentials [12]. It is an open source software application which was developed in collaboration between MIT Media Lab and Learning Machine. The advantage of using this program is that students can send virtual certificates to employers immediately. Without having to rely on the mediator to verify the accuracy of the information. However, the use is also a disadvantage. Because the market of the Bitcoin market fluctuations rates, which makes unpredictable for requirements of issuing academic credentials. Moreover, the Bitcoin network over time makes the system bigger. Resulting in expensive costs for new nodes to join the network.

Gradbase [13] and Stampery [14] are verification system for qualification records that utilizes Bitcoin's Blockchain to use timestamp feature and verify data. Gradbase's system provides an editable transaction model which can check a person's properties by providing information without requiring the user to log in or register an account in the system. Meanwhile, Stampery also uses Ethereum and Bitcoin to proof and offers Blockchain that is scalable to reduce costs.

And in addition to the bitcoin blockchain that is widely used in the issuance and verification of educational certificates, a smart contract built on Ethereum's computing platform is another popular platform for anti-counterfeiting documents. The Open Certificate [15] is a certification platform by Attores, which universities or educational institutions can issue a degree directly through the Blockchain system, resulting from the creation of smart contracts created on the Ethereum calculation platform. While distributed storage systems are similar to storage in Dropbox but are platforms that use Inter Planetary (IPFS) file systems.

## PRELIMINARIES

### A. Paper-based Academic Credentials

Paper-based certificate documents have issued by educational institutions until now. For this process in Thailand are considered very important. It may be because the above documents can be used to confirm the graduation of the person. With the objective for further study or job application. However, counterfeiting of certificate documents is still often seen on the internet news page.

### B. Digital Academic Credentials

Issuing paper-based documents to confirm the completion of the students each year, it has a large number of documents and creates a major problem in finding places for storage. The solution to address the problem is to digitize documents for requires management information systems to reduce storage space and secure. The problem that continues to occur for digital documents is that they are not entirely confident about its quality mainly.

### C. Centralized Databases

Database is a group of data that is collected with a relationship in each other's which does not enforce that all of this information must be stored in the same data file or separate multiple files. Database System is a system that collects various related information together in a systematic way. There is a clear correlation between various data in the database. It consists of several data files that are related systematically to each other and allow users to use, maintain and protect these data effectively with software that operate as a mediator between users and programs, called a database management system or DBMS (data base management system) Its function is to help users easily and effective access information to creation of a database. Database editing or asking questions to get information the user does not need to know about the details within the database structure.

NoSQL is a database technology that is designed for certain specific tasks that SQL is not able to answer sufficiently. Most people are familiar with SQL such as Facebook, Twitter, FourSquare, Digg and so on. Therefore, NoSQL is a database system for supporting large data. Supports system expansion.

In the context of education, editing academic records in the database has more than one unit. There must be a trust level between those authors if multiple entities are writing to the database. For example, one database owner is not willing to allow others to edit items in the database. The best-known solution for the problem of database activation is to create a trusted intermediary or create a central database.

### D. Permissioned Blockchain

Permissioned blockchain has additional functions that are suitable for closed systems or systems that require control to operate according to the instruction set and access rules. In addition, it can solve many of the shortcomings of permissionless Blockchain related to mechanisms, consensus and risk of mining and access and privacy.

By joining the Blockchain node will be added to the invitation process and blockchain is allowed to tend to be more efficient in terms of high transaction volume and low cost and resource usage.

## ANALYSIS

### A. Paper-based vs. Digital Academic Records

Paper-based documents issued by most educational institutions are used for a long time because the documents have to go through multiple approvals. Especially, the document is prepared for study or work abroad, more time than usual certificates. However, documents from the school will be in the form of paper, but also in the digital system of educational institutions as well. Properties of digital documents that are different from paper-based are presented in Table 1

**Table I:** Paper-based and Digital Academic Credentials Characteristics

| Characteristics     | Paper-based<br>from Institution | Digital<br>from Institution |
|---------------------|---------------------------------|-----------------------------|
| Forged              | ✓                               | ✓                           |
| Self-Verification   | ✓                               | ×                           |
| Withdraw or revoked | ×                               | ✓                           |
| Eliminate           | ✓                               | ×                           |

### B. Centralized Databases vs. Blockchain

Centralized server access rights allow both read-write. In order for the data to be private, centralized clients are used. But both the hacking of data to change information from the original can always happen. In Blockchain, everyone can see the same data, but cannot edit other people's data as shown in Table II.

**Table II:** Blockchain and Centralized Databases Characteristics

| Authority Access | Centralized Client | Centralized Server | Decentralized<br>(Blockchain) |
|------------------|--------------------|--------------------|-------------------------------|
| Read oneself     | ✓                  | ✓                  | ✓                             |
| Read everyone    | ×                  | ✓                  | ✓                             |
| Write oneself    | ✓                  | ✓                  | ✓                             |
| Write everyone   | ×                  | ✓                  | ×                             |

### C. Permissionless vs. Permissioned Blockchain

Permissioned and permissionless blockchain vary depending on the purpose of use, whether it is intended to be presented to the public or just a group that is authorized. The following characteristics are shown in Table III.

**Table III:** Permissioned and Permissionless Features

| Blockchain Features | Permissioned | Permissionless |
|---------------------|--------------|----------------|
| Public for all      | ×            | ✓              |
| Flexibility         | ✓            | ×              |
| High storage cost   | ×            | ✓              |
| Longer chain        | ×            | ✓              |

### D. Blockchain-based Solutions

In Table IV, Blockchain implementation for education uses different transactions and results in many forms. Therefore, the results in the table below will be displayed to better understand the collection.

**Table IV:** Blockchain Implementation in Education

| Blockchain in Education | Blockchain System |              |            | Consequence |            | Distributed Consensus |         |          |            |
|-------------------------|-------------------|--------------|------------|-------------|------------|-----------------------|---------|----------|------------|
|                         | Bitcoi<br>n       | Ethereu<br>m | Other<br>s | Digita<br>l | Token<br>n | Po<br>w               | Po<br>S | DPo<br>s | Schem<br>e |
| NazarÃ© et al           |                   |              |            |             |            |                       |         |          |            |
| UNLP &<br>CESYT         |                   |              |            |             |            |                       |         |          |            |
| The Holberton           |                   |              |            |             |            |                       |         |          |            |
| ESILV                   |                   |              |            |             |            |                       |         |          |            |
| BlockCert               |                   |              |            |             |            |                       |         |          |            |
| Gradbase                |                   |              |            |             |            |                       |         |          |            |
| Stampery                |                   |              |            |             |            |                       |         |          |            |
| Open<br>Certificate     |                   |              |            |             |            |                       |         |          |            |
| CredenceLedg<br>er      |                   |              |            |             |            |                       |         |          |            |
| Disciplina              |                   |              |            |             |            |                       |         |          |            |
| EduCTX                  |                   |              |            |             |            |                       |         |          |            |
| Unicert                 |                   |              |            |             |            |                       |         |          |            |

## CONCLUSIONS

Based on the problem of counterfeit certification in this study, many of platforms, has a digital certificate management scheme based on blockchain can be seen from the information in the table above. To demonstrate the system Decentralized That is different from a centralized system that can prevent entry into any person's information without the knowledge of the group The information in the above table also shows that the Blockchain system has 2 types, which allow everyone to use and the form must be allowed to access only. As well as collecting relevant work to conclude that each task is different in any important aspect of Blockchain. With education in the country. We have therefore tried to find information. And bring to create their own platform in the future the platform will help all professionals, institutions and employers.

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