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Blockchain Technology: Can Data Security Change Higher Education Much Better?

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Abstract

Most college celebrities may not be very familiar with blockchain, except maybe for a few people who follow the financial cycle of a cryptocurrency called Bitcoin. Blockchain is a security technology that can replace traditional academic transcripts and provide a new model for sharing scientific information. This makes blockchain a useful learning tool or even as a medium for channeling or storing academic data. Apart from that, Blockchain can also be used to determine the ownership of a person's intellectual property. The proliferation of false credentials micro-credentials encourages academics to be able to strengthen the data security system implemented. Therefore, to strengthen and make it easier to validate the validity of these micro-credentials, this blockchain technology is considered very suitable to be used as a solution. Therefore, in this study the author uses the literature review method with the aim of finding out whether blockchain technology can update the Indonesian education system to a better domain or not.

Keywords: Blockchain, micro-credentials, academic, security level.

1. Introduction

TAlmost all scientific disciplines have been affected by the digital revolution [1], [2], academia is no exception [3]. Traditionally, academic activities not only include learning, but also regarding recording learning outcomes, attendance, administration, student assignments, and all kinds of other forms of academic activities. The effect of digitalization on academia provides opportunities as well as challenges as well as new perspectives on the world of education itself [4]. This makes the world of education inseparable from digitizing computers which are very vulnerable to hackers and all forms of cybercrime [5] as well as simple technical errors. The world of education has also developed rapidly with globalization [6], [7], Cloud Computing [8], [9], and the Internet of Things (IoT) [10], [11] which makes the development of information in the world is exponential so that creating a very large data set which is commonly referred to as Big Data [12], [13]. The emergence of Big Data also raises more complicated problems in the world of academia today [14]. Then how can the academic world provide the information someone needs with Big Data and the crimes that arise in it?

Current possible solutions include a computer system called Blockchain [15], [16]. Of course not everyone knows about this blockchain system, except for people who do follow the development of the crypto monetary finance cycle called Bitcoin [17], [18]. There are still many academic actors who are still blind to this blockchain system, but there are some university experts who have explored this system. There is a report known as 'The 2019 Horizon Report' [19] by several higher education experts who identify that blockchain is an important trend that will affect higher education in the next four to five years. This horizon report focuses on the potential impacts of blockchain on academic credentials, but its application goes far beyond academia itself. Moreover, the use of a decentralized approach [20] also makes blockchain technology capable of having a fairly high level of security. This is considered very very important in line with the emergence of Big Data [12]. This high level of security is able to protect the system from all forms of cybercrime because the process of using blockchain technology is quite complex [21]. This research shows how sophisticated blockchain technology is in its implementation in several aspects or fields, such as in higher education in particular. Based on these things, blockchain technology is considered very useful for any application that requires a trusted application exchange model and can be used as a determinant of a person's intellectual property ownership.

2. What Is Blockchain?

Blockchain [16] was originally designed in 2009 by Satoshi Nakamoto [22] as the building block for Bitcoin (first known as Cryptocurrency). Since then, blockchain has been used to provide information security for different non-financial transactions [23]. Basically, blockchain consists of three main components, namely blocks, nodes, and miners. These main components have their respective duties in a running system that applies blockchain technology. A block is a place or container used to store all types of transactions or information on the blockchain system, while nodes are parties that are members of the blockchain system that have the authority to change or add all types of data and process consensus whether transactions or information eligible or not to be included in the system. It is different with the miner whose job is to add new blocks to the system. Usually, miners add new blocks with special mining methods [24], [25] by solving complex mathematical problems. These three main components form the basis for determining the running of blockchain technology.

There are 4 types of blockchain that are generally known, including Public Blockchain [26], [27], Private Blockchain [26], [28], Consortium Blockchain [29], and Hybrid Blockchain [30]. A brief explanation of the four blockchains is in the table below:

Blockchain types	Advantages of
Public Blockchain	- Open to the public (open source) - Fully transparent to all transactions - Fully decentralized (not controlled by anyone) - Very not censored

	- Owning tokens that are used as incentives or rewards for participants
Private Blockchain	- Also known as permissionless blockchain - Requires permission to join - All transactions are private, only open to the ecosystem - More centralized than public blockchain - Can own or not have a token
Blockchain Consortium	- Owned by a non-individual group - Can be categorized as a subcategory of private blockchain compared to different types - Offers some of the best use cases for blockchain advantage because it comes from a combination of several companies that are b compete healthily - More efficient than private blockchain
Hybrid Blockchain Made	- by Interchain - Using privacy advantages on private blockchain and transparency advantage on public blockchain - Can sort out what data can be published or not - Can post multiple public blockchains at the same time increasing transaction security by implementing hashpower that is on the public blockchain

Table 1. Types of blockchains based on their nature

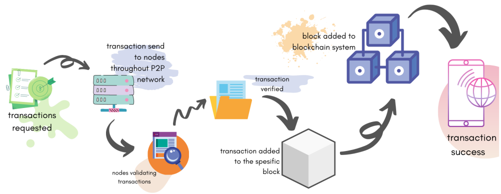

Figure 1. How the blockchain system works The way the blockchain system

How blockchain works is quite complex, but the point is the blockchain system is a decentralized ledger located on different personal computers, which together can control the addition of new data [31], [32]. Data is stored in one block on each server or node in personal computer systems Peer-to-Peer (P2P)[33], [34]. Changes can only be made with the consent of each node. In contrast to systems that rely on a single database server,networks Peer-to-Peer verify data changes by receiving consensus from the nodes concerned [34]. On the blockchain, data is encrypted so only authorized nodes can post changes. Every time a data block is changed, the new block is linked to the previous version to produce a series of interlocking blocks.

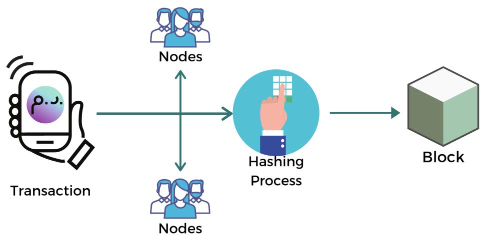

Figure 2. Name of the pic

New blocks that have been linked to existing blocks will become a permanent part of the blockchain. The resulting link from the blocks will form a chain with each hashtag different. Hashtag [35], [36] used by each block can serve as a marker that the block has been modified or not. When the user will initiate an encrypted transaction by changing the data in one of the blocks, then:

- The validated transaction will be collected into a new block and distributed to all nodes on the system. Each new block also includes a linked hashtag from the previous node.
- This validated transaction sharing system is called a peer-to-peer network where there is no single node that regulates the operation of the system so that each existing node can act as a data provider or consumer.
- Each node performs authentication by using a consensus process to verify incoming encrypted transactions. This makes the information very difficult to change due to the need for an encryption key and consensus agreement from existing nodes to change the existing encrypted transaction data. The information added by the source is valid, but not necessarily the accuracy of the information.

In addition, the computer algorithm used will also form a series of letters and numbers, which are commonly known as hash tags. This hashtag method hashing [35], [36] identifies each piece of information in a unique way. The use of this method adds to the complexity of the system used so that the system is increasingly immune to cyber crime attacks because the data that enters the system will be converted into unique codes according to the standards used. The use of this method is also able to maintain the authenticity of the data (originality) because not everyone is able to access every data stored in the system which reduces the potential for changes to information on the data stored in the system. Currently, there are several hash functions that are used according to their needs and security levels [37] - [39], such as SHA256 [40] - [42] which is the second generation of the SHA type. This type has a database of 256 bits which is commonly used for payment processing such as bitcoin because its sending capacity is relatively small and very fast. Besides SHA256, there is RIPEMD160 (Race Integrity Primitives Evaluation Message Digest) developed by MD4. This type has a smaller amount of data than SHA256, which is 160 bits only. Due to its smaller size, RIPEMD160 is faster than SHA256. Commonly used to create accumulated bitcoin addresses based on a public key. There are many other types of hashes.

2.1 Problems In Blockchain

There are four types of blockchain systems in use today, two of which are the unlicensed blockchain system and the licensed blockchain system. The blockchain system without permission means that anyone can join the system and make transactions as freely as possible. This leaves systems vulnerable to a variety of problems, from consensus processing time issues to uncontrolled data growth. Not to mention that they are vulnerable to cybercrime and also irresponsible parties who might insert a lot of fake transactions into the blockchain system that is running [27], [43]. This is why blockchain users prefer to use a licensed blockchain system. A licensed blockchain system has an administrator whose job it is to ensure or control each new node that is potentially trustworthy or not so that it can make a decision whether to add the new node to the system or not. This licensed blockchain system has the potential to reduce the weaknesses that exist in the permissionless blockchain system. However, consensus agreements from authorized nodes still have the potential to contain inaccurate or worthless information. Therefore, other solutions are being developed at present. Although the two types of blockchain have quite significant differences in both form and purpose of use, they still have some similarities. Some of the similarities between the two types of blockchain are:

- Both are still distributed ledger [44], [45]. This means that both blockchain systems have multiple versions of data stored in several different places and routed over certain networks.
- Both are also immutable [46], [47] which means that both data or information stored in the blockchain system cannot be changed by unauthorized parties or nodes.
- Both of them also still use consensus mechanisms [47] which means that the two blockchains have their own way of regulating the type of ledger agreement they want to achieve.

Currently, blockchain has a fairly high level of security compared to other computer systems, but that does not mean that this system is perfect. Many factors cause problems with the blockchain system. Some of the problems with blockchain systems have been summarized by Dan Price [48] who revealed that using fewer nodes can negatively impact the life of the system. Although the use of fewer nodes speeds up consensus processing of the nodes, this actually weakens the system so that it is vulnerable to attacks from cybercriminals or from hackers. For example, if a group of hackers manages to control the blockchain system for more than 50% of all nodes, this will allow them to change all kinds of information on the system. In addition, they are also able to manipulate all kinds of information in the system to cause other chaos. Recent studies have revealed that "bitcoin bandits" have stolen millions of dollars from accounts cryptocurrency simply by guessing security keys that are too simple.

Meanwhile, when viewed from another point of view, it turns out that blockchain technology is still relatively vulnerable to several aspects, such as cryptographic operations, identity, services, virus resistance, and also applications [21]. For example, in the cryptographic aspect, in this aspect, blockchain technology is still vulnerable to block coding or what is known as hashing. Generally, current blockchain technology uses SHA256 operations and implementations. This type is considered a very robust cryptographic function operation. But still, SHA256 is still vulnerable to attacks length extension where the hash of certain messages can be hacked in the form of data modification by extending the data controlled by the attacker without knowing the contents of the data. This attack can wreak havoc on your data. However, this can be prevented by using a double SHA256 according to the statement Ferguson and Schneier. In addition, blockchain technology is still vulnerable to Birthday Attack where this attack is a probabilistic attack that will destroy collision resistance [49], [50] by repeated evaluations.

In addition, the use of blockchain that is open to all users or a blockchain system without permission requires high enough security so that it takes a long time. This long time consumption also consumes a lot of energy. It is estimated that the energy consumed by bitcoin alone takes up as much as 0.6% of the world's electricity consumption [55] - [57]. The use of this energy will continue to increase over time in line with the increasing popularity of the existing cryptocurrency system. Therefore, the applications to be discussed in this paper are those that can be of greatest interest to higher education and avoid the consensus protocol Proof-of-Work energy-consuming that is in bitcoin. This can be avoided by limiting the users that the network administrator usually does.

When viewed from an academic perspective [15], [58], [23], [59], the challenge of blockchain lies in managing data on current academic activities. For example, problems regarding the validity of a person's certificate are submitted to the system. How can blockchain technology be used to validate the certificate and ensure the security of one's certificate [60], [61]. In addition, the endless student data (such as attendance, student grade records, and academic administration) [62], [63] makes blockchain technology both superior and weak. As explained earlier, the advantage here is obtained from the use of blocks that make blockchain data uninterrupted and neatly structured. Blockchain is able to maintain data that is very large in size. The emergence of this huge academic data set is a drawback for blockchain. Blockchain's ability to control every type of activity that exists in an academy is still questionable. The quality of blockchain technology security when viewed from the previous explanation is still considered minimal if it is to be applied in the academic world. Although there are still many methods being used to overcome problems that arise in the application of blockchain technology. In addition, the use of energy needed by blockchain technology also worsens existing problems. It is known that based on the high energy use of bitcoin, it can be used as a reflection of blockchain technology that this technology has a high cost to use.

2.2 Scientific Literature Related To Blockchain

There are a number of situations related to scientific literature that could be addressed or improved using blockchain technology. Because open access journals have grown rapidly, asking for fees as a condition for publishing articles has become commonplace. This makes it difficult for writers who lack institutional funding or funds to pay for publication [64]. Some types of scientific work are not immediately publicized but deserve recognition, for example, serving on an editorial board or helping to review a scientific work or paper. A study on this subject has reported that peer reviewers are more dominant in wanting more recognition of the scientific work they write. Some professors are hesitant to present teaching tactics, curricula, and other materials (e.g. programming learning files) online for fear that their validity of ownership will be lost, and some may feel that they should be compensated more favorably in terms of reputation. or finance when they share their work with others. This blockchain technology is a new technology that is also unique. This makes a lot of experts or developers who still have not put their faith in blockchain technology. Experts still feel that this blockchain technology is still vulnerable in several aspects, such as identity, security, and applications used.

Based on the proposal stated by Joris Van Rossum [65] that blockchain can be used to create scientific data that is more conducive and more reproducible and can choose who first creates an idea or procedure. He is of the opinion that this article only describes the final output based on the work of a scientist, blockchain can record all steps from initial idea to experimental design and final output. He also suggested that researchers could get blockchain tokens for certain professional tasks that could be used to purchase services, for example access to articles or fees to be published in open access journals. This will support researchers who lack financial support to meet certain requirements for publication. Van Rossum stated a lot of things that make sense to this blockchain technology. Cisco [66] even predicts that the use of blockchain will build an open market for innovation that will drive discovery by allowing individuals to be credited for their contributions in previously impossible ways. In addition, in the world of chemistry, the Royal Society of Chemistry [60], [67], [68] shows charter status to be a way to recognize the knowledge & professionalism of those working in chemistry, and other Internet sites to build new forms of relationships between scientists. Blockchain can be a useful addition to these types of sites. Journal publishers will undoubtedly want a better way to trace the origin of articles on Sci-Hub, a pirated journal site. Using blockchain to deploy academics will clarify ownership and perhaps even provide financial compensation procedures. Blockchain can be used to ensure perfect credit or ownership for patents or other intellectual property.

Several projects are underway using blockchain to build an integrated platform that will combine social media scientific networks, a decentralized journal environment, and a funding platform. Scienceroot [69], a company that relies on blockchain-based science tokens that is building a scientific marketplace where researchers can exchange funds,scientific crowdfund projects, and distribute scientific articles. Scienceroot also allows fellow reviewers to introduce the use of tokens that can be used to participate in the process, either in the form of paywalls or a centralized publishing company that controls the process. Project Aiur [70] is a similar attempt to create an example of the online economy of blockchain tokens to compensate researchers who share a research sense making it useful for peer review, or publishing on the platform. Ultimately, the success of these projects will depend on the judgment of the scientific community deciding whether or not the project is successful by means of appropriate assessment standards.

2.3 Is Blockchain able To Create A More Secure And Accessible Academic Note?

As academic qualifications become increasingly complex. Students who currently attend more than one higher education institution require them to provide multiple transcripts when applying for jobs [62]. The rapid development of technology makes lifelong learning a necessity and not just a term. It has also attracted the attention of higher education institutions to develop new ways to certify skills that are more personalized, practical, and targeted [71]. Universities are therefore encouraged to create innovative forms of academic certificates to recognize specific skills developed through relatively short experiential learning, such as short courses on campus or online mass open courses (commonly known as MOOCS) [72], [73] . For students who spend their entire lives playing mobile games, social media and other things on their phones and tablets, the process for getting a certificate seems complicated. Blockchain provides a great way to verify this experience.

The US Census Bureau recently reported that in addition to post-secondary degrees awarded by universities or colleges, more than 50 million American adults, or 1 in 4 adults, have also obtained a professional certificate, license, or educational certificate. . This form of recognition is called a micro-credential, which may include a badge, certificate, and so on. These micro-credentials can come from non-academic or academic sources. Even in traditional undergraduate programs, some laboratory courses (such as instrumental analysis) often employ learning in turns and generally form small groups of students [74], [75]. Even this method does not guarantee that all students in the group have the opportunity to master every tool being taught. Certain blockchain verification tool badges will show potential employers that the student has the specific skills required. As has been done by Towns and Harwood [76], [77] who use badges to ensure students master basic laboratory skills, including pipettes, burettes reading, and preparing solutions in measuring flasks. In addition, Mellor et al. [76], [77] successfully combined gamification and badges to teach Green Chemistry. Micro-credentials can provide potential employers with a more detailed picture of what students have learned during their studies.

Blockchain provides a way to unify all student academic certificates on a platform that is easy to share and authenticate, and can ultimately replace transcripts. A study a few years ago found that 58% of employers found that the information on an applicant's resume was incorrect [60], [61]. Therefore, a better process to make applicants' information more reliable will clearly benefit employers. This may mean that the employee does not have the necessary qualifications for the job, but it may also allow someone to use confidential intellectual property that they would steal. There are several projects that have demonstrated the feasibility of using a blockchain-based platform to create verified scores and / or credit records for higher education, such as Sharples and Domingue [78], and Turkanovic [79]. Massachusetts Institute of Technology (MIT) [80] created an experimental program that allows multiple students to securely create and share transcripts. An international organization of nine major universities has formed a consortium to use blockchain to establish standard procedures for the creation, storage and certification of academic certificates.

Non-academic organizations also propose to provide blockchain credentials so that individuals do not have to incur costs and technical troubles to build a blockchain network.infrastructure companies Cloud such as Microsoft, IBM, and Amazon [81], [82] are developing manageable credential services based onservices cloud their, which enable individuals and organizations to create and manage their credentials, while Pearson and McGraw-Hill (Education providers like McGraw-Hill) are also not left behind. In 2018, the nonprofit World Education Service tried to find better ways to verify qualifications. They started issuing blockchain-based digital badges to applicants as a way of recognizing their qualifications. If higher education institutions fail to respond to this. If needed, they may miss important opportunities to contact and support graduates [83].

2.4 The Potential Of Other Academic Applications Of Blockchain

As information is growing rapidly and the growth of the internet and industry is getting higher. Demand for skilled labor in accordance with company standards is increasing as well [84], [85]. As a result of this demand for experts, the community's competitiveness is quite high. In the midst of this competition, many individuals offer shortcuts to gain recognition so that there is no need for more effort to achieve a certain skill. As a result, a lot of diplomas, certificates, or all kinds of awards have been circulated for certain achievements in education or manipulative professional skills [58], [60], [61]. These many false claims make employers increasingly worried about the quality of their workers. The emergence of this forgery makes employers work more in validating or ensuring the legality or authenticity of the documents submitted by the job seeker.

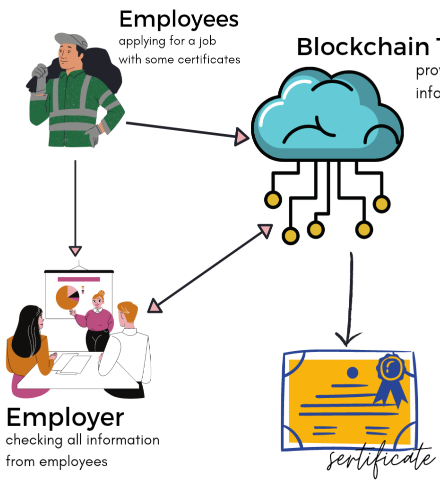

Figure 3. How to verify certificates with blockchain technology

The existence of blockchain technology [86] which can be applied in the world of education is able to help job seekers validate each document accurately, easily, and quickly. In addition, the use of blockchain technology can also be an investment for job seekers because it can reduce costs in validating job seeker documents [83], [87], [88]. In addition, blockchain technology will also record all lifelong educational activities of job seekers so that employers can be more efficient and effective in selecting prospective workers [85]. For job seekers, this blockchain technology is also very profitable. For example, if a person has a lot of academic and non-academic achievements, then with this blockchain technology, he doesn't need to provide any type of transcript or evidence that can validate his expertise.

As commercial supply chains become globalized and more complex, there is increasing demand for understanding the source of the product (the place where the product is made), and how it is transported. Several chemical companies are experimenting with using blockchain technology to solve this case [89], [90]. For example, BASF is already testing the use of blockchain to increase logging and identify cases in their product delivery process. Blockchain can increase restocking efficiency and combat theft or access by individuals who plan to use these chemicals for illegal purposes. If these early efforts prove valuable, blockchain might even have an impact on chemical storage spaces on campuses.

3. Conclusion

The future of blockchain secrecy will be influenced by the willingness of employers and promotion and ownership committees to reward them. This isn't just a case of computer security. Level 2 institutions or journals are not ranked first simply because confidentiality becomes more trustworthy. Academics tend to be conservative, as a result established universities and companies can enjoy profits as providers of blockchain confidentiality. Even if MIT had not investigated the badge of a person whose confidentiality was with MIT, some would still suspect that this badge was more prestigious than the badge on a private server. Likewise, Science Root and Aiur must create a reputation for being a crucial publication before they can be fairly compared using traditional journals.

Blockchain may not be the ultimate solution for computer security cases, however it is more than sufficient to improve its use in some of the aspects mentioned above. As higher education and industry store and share more information on the Internet, unauthorized access and evidence becomes increasingly important. Blockchain may provide a more conducive way of dealing with the origin of this valuable resource. In addition, although there are still many shortcomings, blockchain is also able to minimize the potential for data errors by making it difficult to access the data contained in it. There are so many uses of blockchain that can actually help protect data or information on the system. In the future, it is expected to be able to develop this blockchain system so that it can overcome all types of attacks that are faced.

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