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EXPLORATION OF THE POTENTIAL OF BLOCKCHAIN TECHNOLOGY IN SECURING DATA AND EDUCATIONAL CREDENTIALS

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Abstract

Blockchain technology has emerged as a potential solution for ensuring data security and integrity in various fields, including education. In this publication, we explore the potential of blockchain technology in securing educational data and credentials. We start by providing an introduction to the basic concepts and principles of blockchain technology. Next, we explain how blockchain technology can be used to create a secure and trusted system for storing educational data, including academic history, certificates, and transcripts. We also discuss the use of blockchain in securing educational credentials, such as degrees and certificates, as well as concepts such as credential tokenization and decentralized verification. We identified possible advantages to be gained from the application of blockchain technology in education, including increased security, transparency, and reduced administrative costs. However, we also acknowledge challenges, such as scalability, privacy, and legal and regulatory barriers. Through case studies and existing implementation projects, we provide real-life examples of how blockchain technology has been tested and applied in educational contexts. In conclusion, blockchain technology has great potential for securing data and educational credentials. In an educational context, blockchain can improve security, transparency, and efficiency. However, challenges and barriers need to be overcome for the application of blockchain in education to become more widespread and successful.

Keywords : Blockchain Technology, Educational Data, Credentials, Security.

Abstrak

Teknologi blockchain telah muncul sebagai solusi potensial dalam memastikan keamanan dan integritas data di berbagai bidang, termasuk pendidikan. Dalam publikasi ini, kami melakukan eksplorasi potensi teknologi blockchain dalam mengamankan data dan kredensial pendidikan. Kami memulai dengan memberikan pengantar tentang konsep dasar dan prinsip teknologi blockchain. Selanjutnya, kami menjelaskan bagaimana teknologi blockchain dapat digunakan untuk menciptakan sistem yang aman dan terpercaya untuk menyimpan data pendidikan, termasuk riwayat akademik, sertifikat, dan transkrip. Kami juga membahas penggunaan blockchain dalam mengamankan kredensial pendidikan, seperti gelar dan sertifikat, serta konsep seperti tokenisasi kredensial dan verifikasi terdesentralisasi. Kami mengidentifikasi keuntungan yang mungkin diperoleh dari penerapan teknologi blockchain dalam pendidikan, termasuk peningkatan keamanan, transparansi, dan pengurangan biaya administrasi. Namun, kami juga mengakui adanya tantangan, seperti skalabilitas, privasi, dan hambatan hukum dan regulasi. Melalui studi kasus dan proyek implementasi yang ada, kami memberikan contoh nyata tentang bagaimana teknologi blockchain telah diuji dan diterapkan dalam konteks pendidikan. Kesimpulannya, teknologi blockchain memiliki potensi besar untuk mengamankan data dan kredensial pendidikan. Dalam konteks pendidikan, blockchain dapat meningkatkan keamanan, transparansi, dan efisiensi. Namun, tantangan dan hambatan perlu diatasi agar penerapan blockchain dalam pendidikan dapat menjadi lebih luas dan sukses.

Katakunci: Teknologi Blockchain, Data Pendidikan, Kredensial, Keamanan.

Introduction

In today's digital era, data and information have a crucial role in various aspects of life, including education. Education data, such as academic history, certificates, and credentials, become an important basis in the process of admission, recruitment, and recognition of individual achievement. However, data security and integrity challenges are still a major concern in an increasingly digitally connected environment.

In recent years, blockchain technology has emerged as a potential solution to address data security and reliability issues. Blockchain is a distributed system that allows encrypted and transparent recording of transactions in blocks connected to each other. The uniqueness of this technology lies in its ability to create consensus among all nodes in the network, so that data cannot be manipulated or changed without collective consent. Blockchain is a technology developed by Satoshi Nakamoto and first used to create the virtual currency Bitcoin. This technology has smart contract characteristics that allow its use in various systems, including enterprise applications. Blockchain is considered secure, immutable, distributed, and transparent, so it can be used to ensure data reliability, privacy protection, and reduce falsification of official documents. In the context of education, blockchain can be used to streamline instructional processes, monitor various systems within universities, as well as facilitate university operations (Wasriyono, 2022).

In the context of education, the application of blockchain technology can provide a secure, trusted, and efficient solution in securing educational data and credentials. Today, education data is often stored centrally in educational institutions or third parties, which are vulnerable to security risks and data manipulation. Using blockchain, educational data can be recorded in encrypted blocks and distributed across the network, reducing the risk of manipulation and providing a higher level of security.

In addition, blockchain can also be used to secure educational credentials, such as degrees and certificates. Today's credential verification process is often complex and time-consuming, with many educational institutions and third parties involved. Using blockchain, educational credentials can be converted into encrypted digital tokens, which can be verified in a decentralized manner by authorized parties. This can simplify and speed up the credential verification process, as well as reduce the risk of counterfeiting. Blockchain can be used in education to record and verify academic achievements, certificates, and transcripts in a decentralized and secure manner. By using blockchain, educational institutions can ensure the authenticity and integrity of these documents, as well as provide easier access for students and related parties to verify academic history. In addition, blockchain can also be used to create a secure digital identity system for students and academic staff. This can help reduce the risk of falsifying identities and academic documents (Huaqun Guo, 2022). The application of blockchain in education can include the use of this technology to ensure data reliability, privacy protection, and reduce falsification of official documents (Wasriyono, 2022).

However, although blockchain's potential in education is promising, there are still some challenges that need to be overcome. The scalability of blockchain, i.e. the ability to process large amounts of transactions in a short period of time, is still a major concern. Data privacy protection is also an important aspect to consider, given the transparent nature of blockchain technology. In addition, legal and regulatory barriers also need to be considered in the use of blockchain in an educational context.

In this publication, we will further explore the potential of blockchain technology in securing data and educational credentials. With proper adoption, blockchain can help reduce transaction costs, increase transaction speed, and enable more effective collaboration between different parties in a network (Huaqun Guo, 2022). We will discuss the basic concepts of blockchain, its possible applications in educational data storage, as well as the benefits and challenges associated with using blockchain in education. With proper adoption, blockchain can

help reduce transaction costs, increase transaction speed, and enable more effective collaboration between different parties in a network (Huaqun Guo, 2022). Through a better understanding of blockchain technology, it is expected to create innovative and secure solutions in managing data and educational credentials.

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Methods

In this study, the method used is a comprehensive literature review to understand the basic concepts of blockchain technology and related research in an educational context. Furthermore, case studies were conducted on educational institutions that have adopted blockchain technology to collect data on its implementation, challenges, benefits, and impacts. The collected data are analyzed using thematic analysis and organized in discussions that combine research findings with relevant literature and provide conclusions and recommendations for further research and implementation.

Results and Discussion

By using blockchain technology, educational data can be stored in a decentralized manner. This means that data is not centralized in a single authority, but distributed across peer-to-peer networks. In an educational context, this can reduce the risk of data loss or manipulation, as every transaction that takes place on the blockchain must be approved by most network participants.

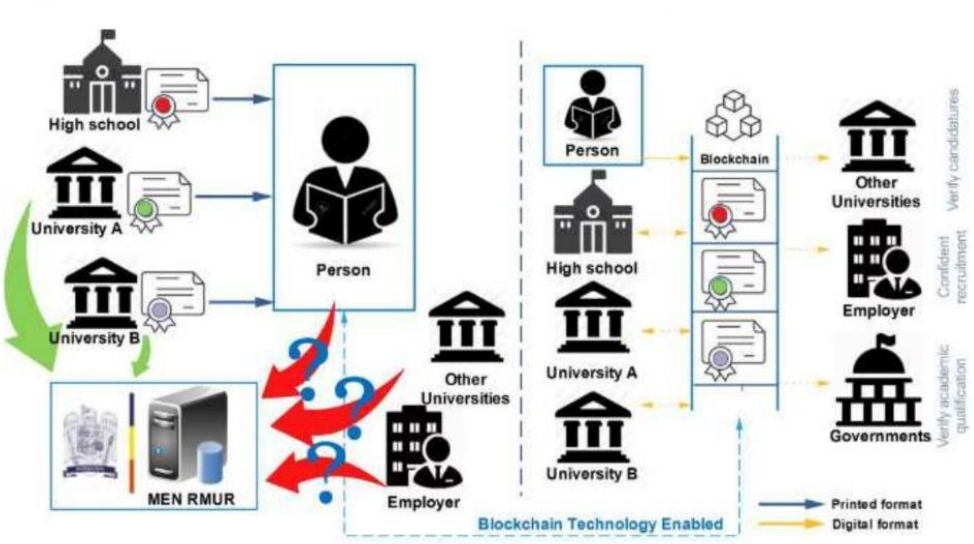

Figure 1. Blockchain technology models for education
Source: LP3I Polytechnic Journal

In addition, blockchain also offers strong cryptographic security. Every data entered into the blockchain is encrypted and linked to the previous block in the chain. This makes it difficult to change existing data without obtaining the consent of the majority of network participants. In the case of educational credentials, such as certificates or transcripts, this can provide a guarantee of authenticity and reduce the risk of counterfeiting.

Blockchain technology can be used to create a secure and trusted system for storing educational data, including academic history, certificates, and transcripts, with several key mechanisms involved.

1. Decentralization: Blockchain provides a decentralized mechanism where educational data is not concentrated on just one central authority. Instead, data is spread across a peer-to-peer network consisting of many nodes or nodes. Each node has a complete copy of the entire blockchain, which allows independent validation and verification of data by other

nodes. This helps prevent data manipulation or information loss because there is no single point of failure.

2. Cryptographic Security: Every data entered into the blockchain is encrypted using strong cryptographic algorithms. The data is then linked to the previous block in the chain using a hash function. This means that any change to the previous block will result in a change to that block's hash, thus making it difficult to change existing data without gaining the consent of the majority of network participants. In this case, the academic history, certificates, and transcripts stored in the blockchain become immutable and provide a guarantee of authenticity.
3. Smart Contracts: Smart contracts are programming code that is executed automatically when specified conditions are met. In an educational context, smart contracts can be used to automatically manage and validate data changes. For example, when a student completes a course or obtains a certificate, a smart contract can automatically update their educational data in the blockchain, verify the achievement, and generate an encrypted digital certificate.
4. Open Verification: In a blockchain, stored information can be openly verified by anyone who has access to the blockchain. It allows interested parties, such as recruiters or other educational institutions, to verify the authenticity of a student's certificate or academic history by examining transactions recorded in the blockchain. As such, increased transparency and accessibility can help prevent counterfeiting and increase trust in education data.

Overall, the use of blockchain technology can create a secure, trusted, and immutable system for storing educational data, including academic history, certificates, and transcripts. With decentralization, cryptographic security, smart contracts, and open verification, blockchain provides a potential solution to improve the security, reliability, and validity of educational data.

The use of blockchain in securing educational credentials, such as degrees and certificates, as well as concepts such as credential tokenization and decentralized verification. Credential tokenization involves using blockchain to represent and secure educational credentials in the form of digital tokens. The token stores relevant information about credentials, such as degrees, certificates, or academic qualifications. Each credential token has a unique identity associated with its owner. Using blockchain technology, credential tokens can be encrypted and linked to previous blocks in the chain, thus providing high security and integrity. The token can also be transferred between its owners in a secure and verified manner. Then, decentralized verification is a concept where the verification of educational credentials does not depend on one single authority, but is done in a decentralized manner by nodes in the blockchain network. Each node in the network can verify the validity of credentials by examining transactions recorded in the blockchain. This eliminates the need to rely on third parties who may introduce security risks or vulnerabilities to counterfeiting. Decentralized verification also allows for a faster and transparent verification process, where interested parties can directly verify credentials without the need to involve intermediaries. In the context of using blockchain to secure educational credentials, the following advantages can be identified such as security: the use of blockchain technology provides a high level of security to educational credentials. The data stored in the blockchain is encrypted and difficult to manipulate or forge without the consent of the majority of network participants, authenticity: by using the blockchain, the authenticity of credentials can be verified easily, as the data can be accessed openly and transparently by interested parties. This helps prevent counterfeiting and increases trust in the credentials provided, as well as Efficiency and Transparency: Decentralized verification enables a faster and more transparent verification process. Interested parties can verify credentials directly by accessing data recorded in the blockchain, without the need to involve third parties or wait for time-consuming manual processes.

There are several advantages of using blockchain technology in education, including streamlining university instructional and operational processes, reducing falsification of university transcripts and official documents, ensuring transparency, data reliability, and data privacy protection in the teaching and learning process, making a major contribution to the education sector. In addition, blockchain technology can also be used to facilitate university operations, monitor various systems within the university, as well as provide benefits such as transparency, data reliability, and data privacy protection (Wasriyono, 2022).

The application of blockchain technology in education can provide several significant advantages, including increased security, transparency, and reduced administrative costs such as High security: Blockchain provides a high level of security for educational data. By using cryptographic encryption and an immutable block chain structure, educational data in the blockchain becomes difficult to manipulate or falsify. This helps protect data integrity and prevents falsification of educational credentials. In traditional systems, educational data can be exposed to security risks, such as identity theft or document forgery, but with blockchain, those risks can be significantly reduced, transparency and Easy Verification: Blockchain provides a high transparency mechanism in the storage and verification of educational data. The information stored in the blockchain can be openly verified by all interested parties. This allows independent verification and builds trust in educational credentials. Parties such as recruiters, educational institutions, or employers can easily verify a student's academic history, certificates, or transcripts without having to rely on external data sources, reduced administrative costs: The implementation of blockchain technology can reduce administrative costs associated with managing educational data. In traditional systems, the maintenance and processing of educational documents requires significant time and human resources. By using blockchain, some administrative processes can be automated through smart contracts, thereby reducing the need for human interaction and saving administrative costs. In addition, blockchain also reduces the need for third parties to verify credentials, which can reduce costs associated with third-party services, reliability and data portability: In blockchain, stored educational data has high reliability. The data is not centralized on a single entity, and each node in the network has a complete copy of the entire blockchain. This reduces the risk of data loss or corruption because there is no single point of failure. In addition, the use of blockchain also allows for better data portability. Students or graduates can easily transfer their credentials to another institution or to an employer without the need to involve complicated manual processes.

However, despite its promising potential, the use of blockchain technology in an educational context is also faced with several challenges. Like Scalability: Scalability is one of the major challenges in the use of blockchain. If used on a large scale to store and verify the educational data of thousands or millions of individuals, blockchain can face low performance and throughput issues. The process of verifying transactions in a blockchain requires consensus from network nodes, which can limit transaction speed and capacity. To overcome these challenges, further research and development is needed to improve the scalability of blockchain technology, such as the use of more efficient consensus algorithms or off-chain scaling techniques, Data Privacy: Data privacy is a sensitive subject in education. Although blockchain offers high security, the information stored in the blockchain is permanent and transparent. This means that all transactions and associated data can be accessed by all participants in the network. In the context of education, there is a need to protect the privacy of students' personal data, such as personal data, academic history, or other sensitive information. Solutions such as encryption techniques or the use of permissioned blockchains can help address these privacy challenges, Legal and Regulatory Barriers: The application of blockchain technology in education also faces legal and regulatory challenges. Each country has a different legal framework related to the use of blockchain technology, especially in terms of the legal validity of digital credentials or certificates issued in the form of tokens. In addition, data protection regulations, such as the General Data Protection

Regulation (GDPR) in the European Union, should also be considered when storing and processing educational data in blockchain. On a large scale, blockchains can face delays and high transaction fees. In addition, compliance with data privacy and data protection regulations also needs attention. Due to the decentralized nature of blockchain, there are challenges in ensuring compliance with applicable privacy laws.

Several case studies have been conducted to explore the potential of blockchain technology in securing data and educational credentials. Here's an example:

1. MIT Media Lab - Blockcerts: MIT Media Lab has developed a project called Blockcerts, which uses blockchain technology to provide secure and verifiable digital certificates. Blockcerts allows educational institutions to issue digital certificates related to academic achievement, such as degrees, course certificates, or other achievements. These certificates are stored in the blockchain, which ensures their authenticity and integrity. Using blockchain, third parties, such as employers or other educational institutions, can easily verify certificates without having to rely on external data sources.
2. Learning Machine and University of Malta: Learning Machine, a company focused on blockchain solutions for education, has teamed up with the University of Malta to apply blockchain technology in the management of educational credentials. In this project, they use a blockchain platform called Blockcerts to store digital certificates and student transcripts. University of Malta students can easily access and share their digital certificates with third parties, such as employers, while third parties can verify those credentials quickly and easily.
3. Sony Global Education and Fujitsu: Sony Global Education (SGE) and Fujitsu collaborated to develop a blockchain-based academic management system. They use blockchain technology to validate and store academic data, such as academic history, awards, and certificates, with the goal of increasing security and transparency. This system allows students to securely control and share their academic data with permitted third parties, such as potential employers or other educational institutions.
4. University of Bahrain and Learning Machine: The University of Bahrain (UOB) is working with Learning Machine to apply blockchain technology in the storage and verification of student transcripts. In this project, UOB uses the Blockcerts blockchain platform to issue verified and secure digital certificates to students. The certificate includes information about courses completed and grades earned. By using blockchain, UOB can improve the security and integrity of student transcript data and simplify the verification process by third parties.

This case study shows how educational institutions and technology companies are working together to apply blockchain technology in securing educational data and credentials. The use of blockchain in these cases helps ensure the authenticity, integrity, and transparency of educational data, as well as facilitate a more efficient verification process. Further research and development continues to explore the potential of blockchain technology in improving the security and effectiveness of education. Blockchain technology can be used to streamline instructional processes, reduce falsification of transcripts, facilitate university operations, as well as make a major contribution to the education sector. Blockchain technology can also provide benefits such as transparency, data reliability, and data privacy protection in an educational context (Wasriyono, 2022).

The application of blockchain technology in vocational higher education has the potential to optimize business processes in educational institutions, increase the effectiveness of educational processes, and minimize fraud. In addition, blockchain technology can also include digital identity

management, distributed storage in the cloud, and decentralized surveillance, with socio-technological features supporting its application (Nugraha, 2020).

Exploration of the potential of blockchain technology in securing data and educational credentials shows significant benefits in improving data security and integrity. In implementing this technology, it is necessary to consider existing challenges, such as scalability and privacy compliance. Nonetheless, with further development and appropriate solutions, blockchain technology has the potential to make a valuable contribution in improving data security and reliability in education.

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Conclusion

In this journal article, we have explored the potential of blockchain technology in securing data and educational credentials. Case studies that have been conducted show that the use of blockchain in educational contexts can improve data security, integrity, and transparency, as well as facilitate efficient verification. Blockchain technology allows educational institutions to issue verified digital certificates, which can be accessed by students and verified by third parties. Based on the research and case studies that have been conducted, here are some recommendations for the application of blockchain technology in securing educational data and credentials, namely collaboration between educational institutions and technology companies because this collaboration can accelerate the development and implementation of blockchain technology in an educational environment. Further research and development because further research and development is needed to improve the scalability, privacy, and security of blockchain technology in the context of education, compliance with laws and regulations, education and socialization because it is important to provide education and socialization to stakeholders, such as students, administrative staff, and employers, regarding the benefits and uses of blockchain technology in securing data and Educational credentials.

References

Buterin, V. (2017, Oct 17). *Vitalik Buterin's personal blog*. Retrieved 2018, from https://vitalik.ca/general/2017/10/17/moe.html

Huaqun Guo, X. Y. (2022). A survey on blockchain technology and its security. *Blockchain: Research and Applications*, 13, 14, 15.

Kampakis, S. (2018). *The Data Scientist*. Retrieved 2018, from http://thedatascientist.com/valuing-ico-crypto-tokens/

Kimlic, LTD. (n.d.). *Kimlic*. (Kimlic) Retrieved 2018, from http://kimlic.com/

Nugraha, A. C. (2020). PENERAPAN TEKNOLOGIBLOCKCHAIN DALAM LINGKUNGAN PENDIDIKAN. *jurnal produktif*, 6.

Wasriyono, D. A. (2022). Inovasi Pemanfaatan Blockchain dalam Meningkatkan. *Jurnal Mentari: Manajemen Pendidikan dan Teknologi Informasi*, 9.