Journal of Computer Science Advancements, 2(1) - February 2024 1-18

The Impact of Implementing Blockchain Technology in Learning on Data Security and Integrity

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Article Information:
Received January 10, 2024
Revised January 19, 2024
Accepted February 5, 2024

ABSTRACT

The application of blockchain technology in learning has great potential to improve data security and integrity. Because blockchain is a decentralized technology that uses block chains to record and secure transactions in a transparent and permanent manner, it offers an excellent solution to address security and data integrity issues. This research was conducted with the aim of improving the security and integrity of student data. Student data can be stored in a distributed manner with blockchain. No one can change or delete it without their permission. This goal also includes increasing transparency and accountability of the learning process to ensure that the data used in the learning process is accurate data. The method used in this research is a quantitative method. This method is a way of collecting numerical data that can be tested. Data was collected through distributing questionnaires addressed to students. Furthermore, the data that has been collected from the results of distributing the questionnaire will be accessible in Excel format which can then be processed using SPSS. From this research carried out, researchers can obtain research results that blockchain technology is used to protect educational data by locking the learning history of the learning management system (LMS), so that assessments can be carried out effectively and allow all parties involved to access and verify information safely while ensuring data integrity and validity. Based on the results of this research, it can be concluded that the application of blockchain technology can help improve the security and integrity of student data, such as academic, financial and personal data, in the learning context. By using blockchain, students have complete control over their data and ensure that bad people cannot misuse or access it. Apart from that, blockchain technology can also increase transparency and accountability in the classroom.

Keywords: *Blockchain, Integrity, Security*

Journal Homepage https://journal.ypidathu.or.id/index.php/jcsa

How to cite: Adhicandra, I., Kaaffah, M, F., Maharaja, H, C., & Sabri, Sabri. (2024). The Impact of Implementing Blockchain Technology in Learning on Data Security and Integrity. *Journal of Computer Science Advancements*, 2(1). 1-18 https://doi.org/10.70177/jsca.v2i1.927
Published by: Yayasan Pendidikan Islam Daarut Thufulah

INTRODUCTION

The increasing number of technologies supported by adequate facilities and infrastructure shows that information technology has become a very vital need for human life (Balke et al., 2018). With these technological advances, the use of technology by some irresponsible people has also taken advantage of the opportunity to attack individuals and organizations with various techniques (Kershenbaum et al., 2019). Therefore, security is needed in various technological fields, especially in the fields of education and learning. This aims to prevent some people who misuse this technology from attacking or using someone's personal data for inappropriate things (Chew et al., 2020).

Certificates and individual learning records, which demonstrate a person's abilities and achievements, are essential for the development of educational blockchain applications to solve the problem of trust in the field of education (Gavurová et al., 2018). These certificates and diplomas are critical to the market and education, and therefore must be stored in a readily available ledger that is resistant to long-term damage (Kim et al., 2018). Blockchain technology not only solves this problem, but also makes it possible to adapt to the new trend known as open data. In the application of blockchain technology, all transactions will be recorded and verified permanently, blockchain technology is even great for storing fingerprints of certificates or other educational items (Ma et al., 2018).

One of the main characteristics of blockchain technology is decentralization, traceability, immutability, transparency, and the ability to handle currency properties (Toufaily et al., 2021). By using these technical features, it is possible to create a system that excels in terms of reliability, trust, security and efficiency. Blockchain technology offers a fast, secure, valid and certain way to carry out transactions as well as a reliable distributed control mechanism (Lim et al., 2021). Since the data is public and the encryption method is virtually inviolable, the possibility of breach is eliminated (Khalaf et al., 2020). Blockchain technology is no longer limited to cryptocurrencies or the economy, although it was originally used for digital currencies (Bitcoin).

Blockchain technology is an ideal tool to solve online education problems such as insecure data. There are other fields of application of blockchain technology such as finance, the Internet of Things (IoT), and other technologies that most often use this technology (Bai & Sarkis, 2020). Digital currencies, currency transfers, exchanges, and payment systems are common financial applications. Types of smart contracts such as

bank loans, shares, and securities can be enforced automatically without human intervention (Wu & Tran, 2018). The first field that uses blockchain technology is education. The impact of implementing blockchain technology can enable student data, including study time, course files and exam results, to be stored in blockchain technology in chronological order. Each data record can be timestamped (Gausdal et al., 2018).

The recording method in the application of cryptography-based blockchain technology can protect data from threats such as tampering or deletion. Any educational platform or institution will be able to record students' learning trajectories across regions and time thanks to decentralization, distributed databases, and collective maintenance of blockchain (Choi et al., 2020). Blockchain-based learning records not only record overall student learning data, but also prevent deletion and tampering which makes them highly secure (Si et al., 2019). At the same time, learning data, protected by encryption technology, can be easily distributed across the network and downloaded by companies. Using blockchain-based data, employers can verify student data and know their learning state.

The application of blockchain technology can make it easier to certify learning outcomes, especially student academic certification. Even if a student's certificate is lost, with blockchain technology it can be easily verified (Rejeb et al., 2019). To ensure data security and credibility, blockchain also uses a cryptographic asymmetric encryption algorithm (Wang et al., 2019). Thus, this set of systems can contain detailed student learning outcomes. Blockchain technology has several unique characteristics that other technologies do not have. The characteristics of Blockchain Technology include independence, trust, transparency, trustworthiness, immutability and disintermediation (Yang, 2019). By combining these six characteristics, blockchain can solve the problem of eliminating third parties.

The main principles of blockchain technology are immutability and transparency, which means that every transaction that occurs will be directly visible and that every data entered and stored on the blockchain cannot be changed (Garg et al., 2021). If you try to change data that is already stored on the blockchain, this will change the hash block, which means the data is no longer valid (Rejeb et al., 2021). In the education sector, the use of blockchain will be very profitable. If implemented seriously, the level of cheating during exams will be reduced because every transaction that occurs on the blockchain will be connected directly to an independent network (Qian & Papadonikolaki, 2020). Every transaction that is recorded efficiently, effectively, safely and transparently in the activity process will be recorded via this blockchain.

The type of method used in this research is a quantitative method. This method is used so that the final results of the data processing can be known clearly and precisely. Based on the explanation of the research above, researchers think that the impact of

implementing Blockchain Technology in Learning can provide security for data integrity during education and learning. And researchers also have a hope that future researchers will research the impact of implementing Blockchain Technology in Learning on Data Security and Integrity in further research and develop research to get maximum results.

RESEARCH METHODOLOGY

Research Design

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Research Subject

In researching the impact of implementing blockchain technology in learning on data security and integrity, researchers of course determine the subject for their research. In this research, the subject of this research is aimed at students from various educational institutions. Before the questionnaire was distributed by the researcher, the researcher asked the respondents first to be able to spend their time filling out the questionnaire that the researcher would distribute. The questionnaire contains 10 questions each about the impact of implementing blockchain technology in learning on data security and integrity.

Research Ethics

In writing an article entitled The Impact of Implementing Blockchain Technology in Learning on Data Security and Integrity, it is very important for researchers to consider ethical or ethical values in carrying out research. Researchers really maintain a balance in conducting research so that they remain consistent and careful in carrying out the research being researched. In this research, the researcher also upholds a commitment he has made, by presenting accurate data related to his research. Apart from that, researchers also try as much as possible to avoid negative things such as plagiarism in their research.

Data Collection and Analysis Techniques

The data collection technique carried out by the researcher aims to identify the relationship as well as be a benchmark for the material of the research study object. In

this research, the researcher performed data collection techniques by using quantitative methods and by using software in the form of a T-test. For that, the researcher needs to present the data in the form of tables and diagrams that will be used in the form of averages or percentages. Furthermore, the researcher also did not forget to make sure that the results of the answers given by the respondents were very accurate and reliable by doing the best tests first. Therefore, researchers must be very careful in collecting the results of data processing.

Table 1. Category Impact of Blockchain Technology Implementation in Learning

No	Earning Category	Level of education	Persentase (%)
1	Strongly Agree	Student	>90%
2	Agree	Student	25-60%
3	Somewhat Agree	Student	10-30%
4	Disagree	Student	5-10%

Figure 1. Data Collection and Analysis Flow

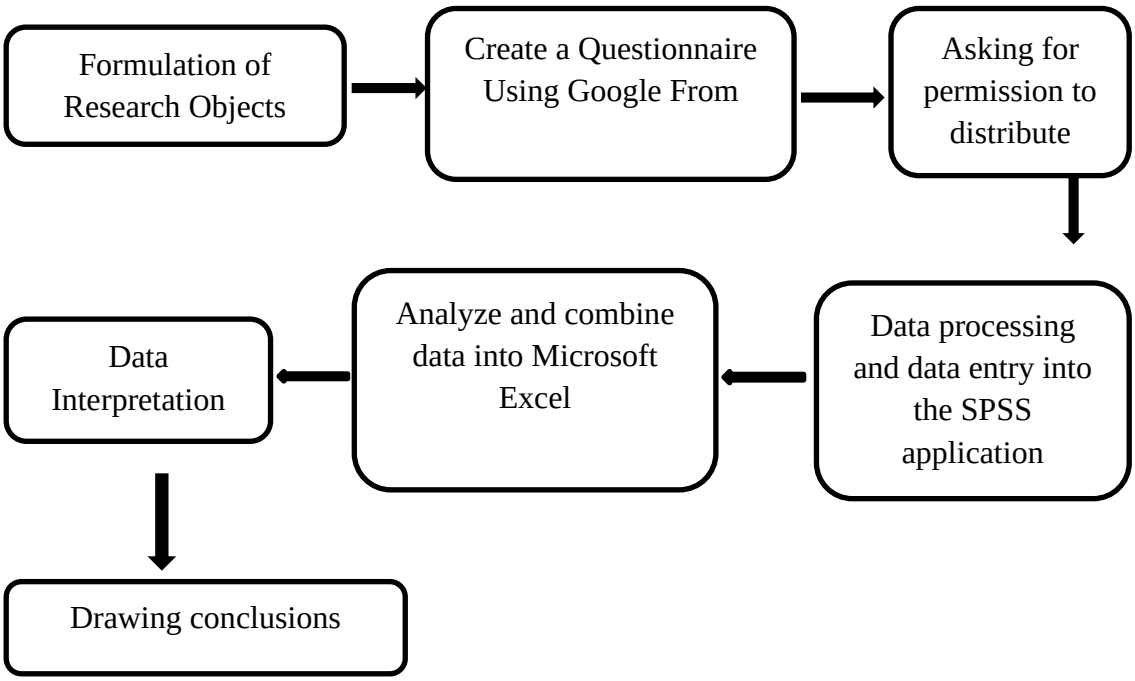

Figure 1 above shows how researchers collect and analyze research data. The results of data acquisition came from respondents' answers to the researcher's questions.

Furthermore, in the quantitative research method, the researcher will also test again using the T-test which will be used to enter research data into the SPPS application. The number of questions asked by the researcher was 20 questions, where each question was divided into ten questions with different questions. Only after the questionnaire has been distributed can researchers formulate and draw conclusions from the research object.

RESULT AND DISCUSSION

Impact of Implementing Blockchain Technology

With advances in digital technology, data can now be accessed, shared and stored easily and efficiently. However, these advances also pose increasingly complex and diverse risks to data security. Data, which is an invaluable asset for organizations and individuals, can influence decisions, generate added value and provide competitive advantages. Therefore, data security is very important. Therefore, data security must be highly considered and incorporated into every aspect of digital transformation. Confidentiality, integrity, and availability are the three main components of data security.

Table 2. Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly Agree	Agree	Somewhat Agree	Disagree
1	The application of blockchain technology in learning increases data security by providing a distributed system that is difficult to manipulate	26%	60%	12%	0%
2	Blockchain enables high transparency in learning by recording every transaction or interaction in an immutable block chain	40%	30%	25%	5%
3	With blockchain, data integrity in learning can be maintained effectively because every change or addition to data requires approval from the majority of entities in the	21%	35%	40%	4%

	network				
4	The implementation of blockchain can reduce the risk of cheating in learning by recording every action taken by participants and instructors	50%	30%	10%	10%
5	Blockchain enables automatic validation of credentials or certifications in learning, reducing the risk of forgery or manipulation	65%	28%	7%	0%
6	In online learning, blockchain can be used to verify participant identity securely and without the need for a third party	35%	20%	44%	1%
7	Blockchain technology allows accurate time recording of each interaction in learning, helping in checking time or deadline compliance	33%	50%	10%	7%
8	By utilizing smart contracts, learning can be automated with predefined rules, increasing efficiency and security	30%	36%	32%	2%
9	Blockchain can be used to track an individual's learning history securely and verifiably, assisting in the evaluation and accreditation process	30%	20%	41%	9%
10	The application of blockchain in learning reduces dependence on central data centers, increasing resistance to cyberattacks	60%	40%	0%	0%

Table 2 above shows the distribution of questionnaires that have been carried out by researchers. This questionnaire contains ten questions about the impact of implementing blockchain technology in learning on data security and integrity. In

addition, during the distribution of the questionnaire, the researcher presented a percentage of each response from the respondents. Therefore, respondents can choose to answer the researcher's questions by providing options such as strongly agree, agree, disagree, or disagree. And it can also be seen from the first question asked by researchers regarding the application of blockchain technology in learning to increase data security by providing a distributed system that is difficult to manipulate, getting the highest score of 60% agree options.

The second question about Blockchain allows high transparency in learning by recording every transaction or interaction in an immutable block chain, getting a percentage result of 40% strongly agreeing. The third question is about With blockchain, data integrity in learning can be maintained effectively because every change or addition to data requires approval from the majority of entities in the network, scoring as much as 40% less agree. The fourth question: The application of blockchain can reduce the risk of cheating in learning by recording every action taken by participants and instructors, getting a percentage of 50% who strongly agree. Next, the fifth question, Blockchain allows automatic validation of credentials or certifications in learning, reducing the risk of forgery or manipulation, there are as many as 65% of the strongly agree option. Next, sixth. In online learning, blockchain can be used to verify participants' identities safely and without the need for a third party, as many as 44% disagree.

The seventh question is that blockchain technology allows accurate time recording of each interaction in learning, helps in checking time or deadline compliance, getting a percentage result of 50% of the agree option choices. In the eighth question regarding By utilizing smart contracts, learning can be automated with predetermined rules, increasing efficiency and security, also found in the agree option as much as 36%. The ninth question about Blockchain can be used to track individual learning history safely and verifiably, assisting in the evaluation and accreditation process, getting a percentage result of 41% who disagree. For the last question regarding the application of blockchain in learning, reducing dependence on central data centers, increasing resistance to cyber attacks, getting a percentage gain of 60% in the strongly agree option.

Table 3. Summary of Percentage Results from Respondents' Answers

No.	Question	Strongly Agree	Agree	Somewhat Agree	Disagree
1	Blockchain technology can help strengthen security in the storage and exchange of sensitive learning materials, such as student or	33%	59%	3%	5 %

	research data				
2	In peer-to-peer learning, blockchain can provide a secure structure for various information and provide feedback between participants	50%	40%	10%	0%
3	Blockchain enables token-based learning, where participants' achievements or contributions are recorded transparently and can provide incentives	70%	20%	0%	10%
4	With blockchain, learning data can be stored securely and encrypted, providing protection against unauthorized access	5%	52%	43%	1%
5	Blockchain technology can help reduce administrative costs in learning by automating data verification and validation processes	57%	33%	10%	0%
6	In a decentralized learning environment, blockchain enables secure and documented collaboration between institutions or individuals	50%	50%	0%	0%
7	The implementation of blockchain increases the reliability of certificates or credentials provided in learning, because data is stored in a decentralized manner	28%	62%	10%	0%
8	By using blockchain, the learning process is more transparent and can be accounted for by all parties involved	39%	35%	15%	11%
9	Blockchain can be used to create a reputation system in learning,	85%	5%	10 %	0%

	where participants' contributions and performance can be clearly monitored				
10	By leveraging blockchain's immutability features, learning can create an audit trail that cannot be manipulated to track every data change	50%	30%	5%	15%

In the statement in table 3 above, the researcher has also created ten questions. Which can be seen from the first question regarding blockchain technology can help strengthen security in storing and exchanging sensitive learning materials, such as student data or research, getting a percentage result of 59% agreeing. Next question number two is about In peer-to-peer based learning, blockchain can provide a secure structure for various information and provide feedback between participants, getting a percentage score of 50% on the strongly agree option. Third question Blockchain enables token-based learning, where participants' achievements or contributions are recorded transparently and can provide incentives, getting a percentage score of 70% strongly agree.

The fourth question is about With blockchain, learning data can be stored securely and encrypted, providing protection against unauthorized access, getting as much as 52% percentage score in the agree option. The fifth question about blockchain technology can help reduce administrative costs in learning by automating the data verification and validation process, getting as many as 57% of options strongly agree. Question six In a decentralized learning environment, blockchain enables secure and documented collaboration between institutions or individuals, also achieving the same percentage gain of 50% on strongly agree and agree options.

Furthermore, the seventh regarding the application of blockchain increases the reliability of certificates or credentials given in learning, because the data is stored decentralized, getting a percentage score of 62% in agreement. The eighth question regarding By using blockchain, the learning process is more transparent and can be accounted for by all parties involved, obtained a percentage gain of 39% strongly agree. In question number nine, that Blockchain can be used to create a reputation system in learning, where participants' contributions and performance can be clearly monitored, was also found in the most strongly agreed option with 85%. The final question is about By leveraging the immutability feature of blockchain, learning can create an audit trail that cannot be manipulated to track every data change, getting as much as 50% on strongly agree options.

Diagram 1

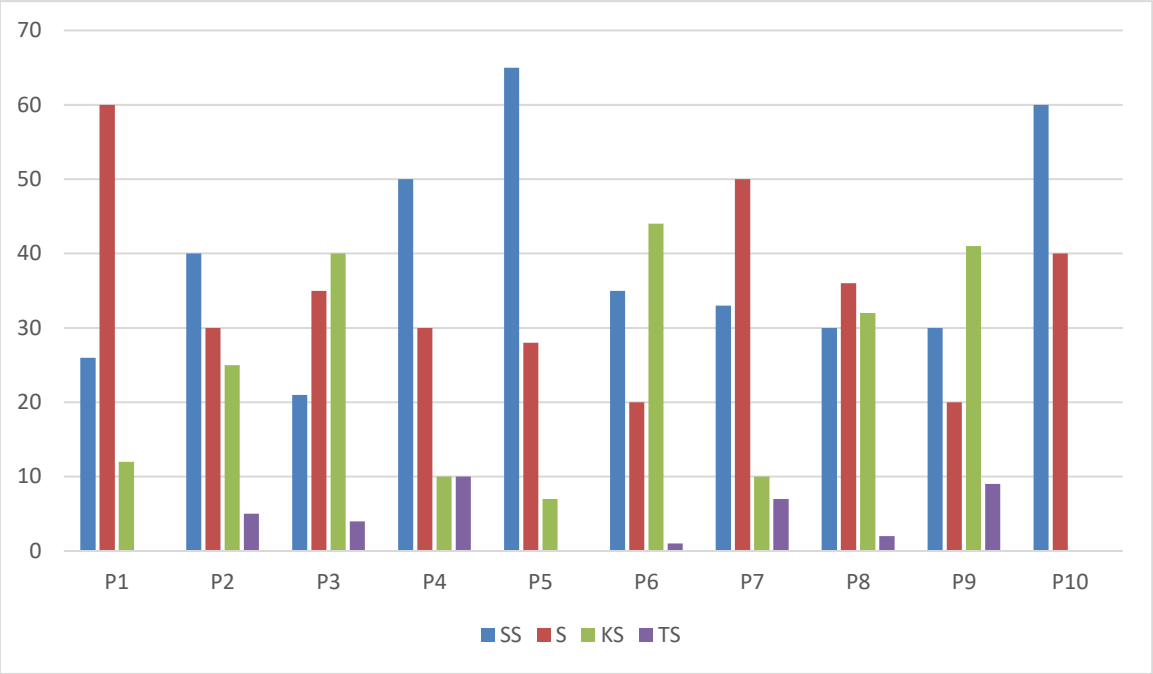

Diagram 2

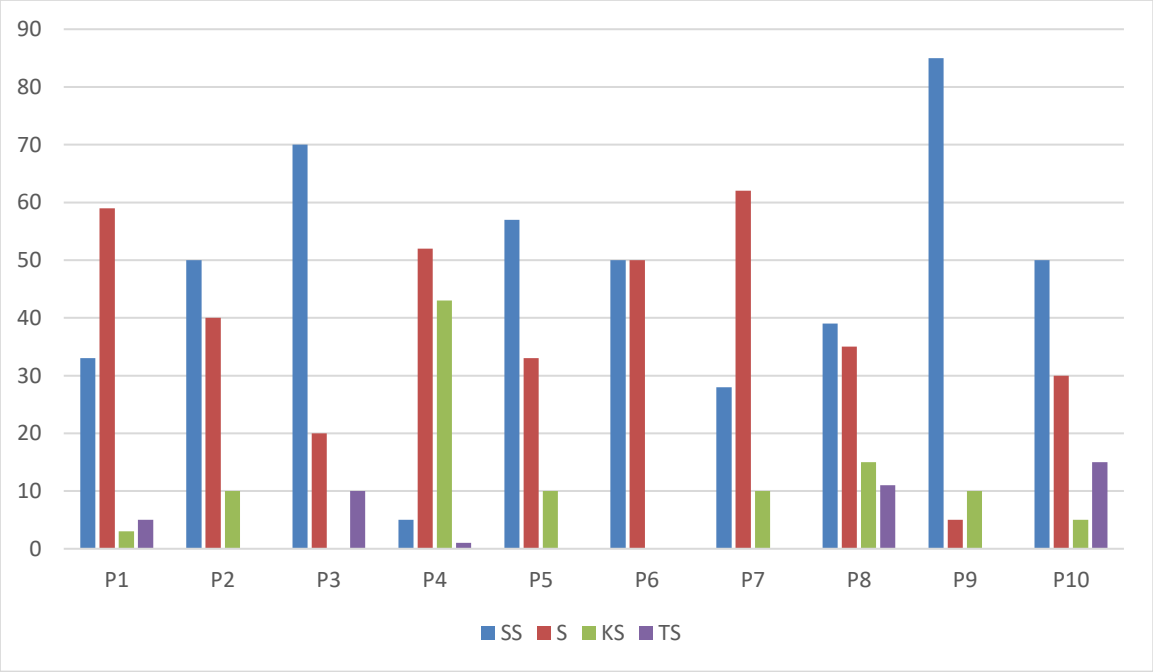

Table 3. T-test regarding the impact of implementing blockchain technology in learning on data security and integrity

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	42.8500	20	18.81566	4.20731
	POST TEST	36.7500	20	15.15143	3.38796

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	-.597	.005

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRE TEST - POST TEST	6.10000	30.40066	6.79779	-8.12795	20.32795	.897	19	.381

Based on the results of table 3 above, it is a T-test using the SPSS application. From the research results, the researcher can conclude that the T-test in the first output section explains the mean as the average. In the Pre Test the average number produced was 42.8500, while in the Post Test the result was 36.7500. Based on these results, it can be formulated that there are differences in the results of the respondents' answers. Next, in the Paired Samples Correlations section, you get a correlation of -597, and the sign size is .005. Next, in the Paired Samples Test section, we obtained a result of 30.40066 in the Std section. Deviation, while in the Std. Error Mean obtained a result of 6.79779. Based on these results, the impact of implementing blockchain technology in learning on data security and integrity.

Table 4. T-test regarding the impact of implementing blockchain technology in learning on data security and integrity

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRE TEST	13.1000	20	15.53231	3.47313
	POST TEST	4.2000	20	5.57815	1.24731

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRE TEST & POST TEST	20	.149	.530

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	PRE TEST - POST TEST	8.90000	15.70082	3.51081	1.55179	16.24821	2.535	19	.020

Furthermore, in table 4, there are also the results of research using the T-test. It can be seen in the first output section that the Pre Test results were 13,1000, and the Post Test results were 4,2000. In the Paired Samples Correlations section, we obtained a correlation of .149, with a sign result of .530. Meanwhile, in the Paired Samples Test section, the results were 15.70082 in the Std section. Diviation, and Std. The mean error is 3.51081. Based on the results of this research, it can be seen between each question asked by researchers regarding the impact of implementing blockchain technology in learning on security and data integrity.

Blockchain technology has many effects on learning (Di Vaio & Varriale, 2020). One effect is increased clarity and security of the education system. Academic data and student information can be stored digitally with blockchain technology, which ensures that information cannot be changed or deleted (Park & Li, 2021). This can help students and parents increase their confidence in the education system. In addition, blockchain technology can help develop more effective and secure online learning systems (Sheel & Nath, 2019). By using blockchain technology, students can learn safely online and ensure that the information they receive is accurate and valid.

The use of blockchain technology in learning increases data transparency, security and accuracy (Upadhyay et al., 2021). Educational information such as academic history, certifications, and student achievements can be stored encrypted and decentralized using blockchain (Tyan et al., 2021). This reduces the possibility of data manipulation and document falsification, increasing trust in the education system. Additionally, blockchain enables the development of more interactive and collaborative educational platforms where teachers and students can participate directly in the creation and validation of course materials (Adam et al., 2023). Therefore, the

application of blockchain technology will not only change the way learning is conducted, but will also increase the overall efficiency and effectiveness of the process.

In today's digital era, it is important to understand data security and integrity (Acquisti & Gross, 2009). With more and more data being stored and transmitted online, it is very important to understand how to protect personal data from cyber attacks and ensure that the information is correct and authentic (Parakh & Kak, 2009). Through a curriculum that covers data security concepts, students can learn to recognize potential cyber threats, implement best practices to protect personal and institutional information, and understand the importance of compliance with regulations and privacy policies Data security courses teach values such as responsibility, ethics, and concern for danger (Bernabeu et al., 2012). They also learn about potential cyber threats and how to best protect personal and institutional data.

It is very important for students to learn about data security and integrity in blockchain technology to ensure that academic data and student information is stored safely and securely (Dirin et al., 2023). By using blockchain technology, students can learn how to develop effective security systems and how to ensure data integrity (Schwartz & Zalewski, 1999). This learning can also help them understand the importance of data security and integrity in the education system, as well as how to develop an effective security system to ensure data integrity (Mishachandar et al., 2021).

The use of blockchain technology in learning can change the security and integrity of data (Ferrag et al., 2019). Its ability to ensure data integrity and transparency through a decentralized data structure is one of the main advantages of blockchain technology (Treleaven et al., 2017). Academic data and student information can be stored safely and securely with blockchain technology. This ensures that people cannot change or delete data. In addition, blockchain technology can help maintain data security which often occurs in the connected digital era, such as identity theft and data leaks (Nandi et al., 2020). Therefore, blockchain technology can be used in learning to improve data security and integrity as well as the transparency and accountability of the education system.

CONCLUSION

The conclusion of this research shows that blockchain technology has a significant impact on the security and integrity of data in learning. Based on the results of the questionnaire that has been distributed, the majority of respondents agree that the application of blockchain technology can improve data security by providing a distributed system that is difficult to manipulate, allows high transparency, and ensures data integrity. In addition, blockchain is also able to reduce the risk of fraud, validate credentials automatically, and securely verify participant identities. The T-test results

also showed a significant difference between the pre-test and post-test results, which indicated that the application of blockchain technology had a positive impact on the security and integrity of data in learning.

In addition to increased security and data integrity, blockchain technology also brings additional benefits such as reduced administration costs, creation of a transparent reputation system, and increased collaboration in a decentralized learning environment. Blockchain enables secure storage and exchange of sensitive learning data, as well as providing protection against unauthorized access. With its immutability feature, blockchain creates an audit trail that cannot be manipulated, helping trace every data change. Overall, the application of blockchain technology in learning not only increases the efficiency and effectiveness of the learning process, but also strengthens trust in the education system.

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