BLOCKCHAIN-BASED AUTHORIZATION FOR EDUCATIONAL IOT PLATFORMS

#1MITTA CHANDRASHEKAR,
MCA Student, Dept of MCA,

#2AKOJU MAHENDER,
Assistant Professor, Department of MCA,

VAAGESWARI COLLEGE OF ENGINEERING (AUTONOMOUS), KARIMNAGAR, TG.

ABSTRACT: Imagine a classroom where the classroom is equipped with cutting-edge technology that makes it simple for students and teachers to communicate with one another. Because of this, learning becomes more specialized. However, despite the fact that the Internet of Things (IoT) has the potential to improve education, people continue to be concerned about accessibility. Using blockchain, a distributed ledger technology that offers both security and openness, this research advocates for the protection of Internet of Things (IoT) networks in educational institutions. Smart contracts work to ensure that only authorized users are able to interact with data and devices. This is because smart contracts are always evolving. Because there is a lower likelihood of data breaches, hacking, and system failures when using this strategy, it is anticipated that future digital learning environments will be safer, more efficient, and capable of expanding.

Keywords: Blockchain, Authorization, Educational IoT, Smart Contracts and Access Control.

1. INTRODUCTION

Technological breakthroughs are dramatically changing our research methodologies. The Internet of Things has expanded. Computers are increasingly handling administrative tasks, allowing pupils to get more individualized education. The use of networked monitors, interactive whiteboards, and RFID-based attendance systems improves the classroom environment, making it more engaging and productive. An rising number of networked devices raises concerns about data privacy and security. Currently, the main problems are permitting secure device integration, protecting data, and monitoring user behaviors.

Historically, educational institutions restricted access to their internet resources by centralized permission systems. All of these instruments are authorized and managed by a single server. This method has been useful for a long time; yet, it has a number of serious limitations. A central computer breakdown or security breach might threaten the entire system. The absence of clarity in these systems makes it difficult to identify persons who have accessed or altered data. The centralization of IoT networks reduces their flexibility and scalability, a drawback that becomes more apparent as the networks expand. Universities and colleges are looking for novel ways to protect their online environments.

Blockchain technology provides an innovative solution to these difficulties. Blockchain operates on a decentralized network, which distinguishes it from traditional systems and eliminates the possibility of a single point of failure. It provides a simple and safe way to manage access and behavior permissions. A permanent digital ledger records all blockchain transactions and access requests. This makes data updates extremely burdensome. By automating permissions, smart contracts—self-executing programs—can ensure that only authenticated users and devices have access to educational websites.

Blockchain technology enhances collaboration and security across organizations. Because of the interconnection of today's world, educational institutions frequently share resources and information. Blockchain technology allows several organizations to independently validate credentials without relying on a single regulatory authority. Blockchain provides a dependable means for confirming identities in digital certifications, online examinations, and collaborative learning, including Internet of Things (IoT) devices. The decentralized trust architecture allows for effective communication between administrators, educators, and students while preserving a high level of security.

Combining blockchain technology and Internet of Things platforms allows educational institutions to create secure, scalable, and robust learning environments. This method reduces common risks like data breaches and unauthorized access by defining roles and responsibilities. Blockchain technology will become increasingly important in protecting student information and academic records as schools adopt digital technologies. Institutions can enhance trust and creativity in education by recording transactions on an unchangeable ledger.

Blockchain-based permission systems will improve over time as more research and pilot efforts are conducted. As a result, their widespread adoption in educational contexts is quite likely. Students' access to educational resources, interactions with educators, and collaboration may be significantly disrupted as more institutions investigate the potential of blockchain technology. The education sector must invest in open and secure technology to ensure a future of intelligent and secure digital learning.

2. REVIEW OF LITERATURE

Tan, R., Wang, H., & Cheng, Y. (2020) The security and privacy of student data is becoming more important as educational technology develops at a rapid pace. In this research, we look at how well blockchain technology can protect educational institutions' IoT data from intrusion. Accountability, transparency, and trustworthy administration of student data are the pillars upon which the authors' self-regulating system rests. By making it easier for

administrators, instructors, and students to share and access information, the suggested technique improves educational outcomes. Blockchain improves data security and scalability, according to performance tests. The use of smart contracts allows for continuous monitoring, which greatly improves the security of online classrooms.

Zhaofeng, Z., Xingang, W., & Peng, Y. (2020) Educational institutions must ensure the strength of their security systems because they handle considerable amounts of sensitive digital data. The authentication mechanism used in this research, which is based on blockchain technology, guarantees the safe transfer and receipt of academic materials. To ensure that only authorized personnel have access to sensitive resources, smart contracts control who can access them and check their identities. By fixing flaws in existing security models, the solution improves privacy and security, protecting users from threats like data breaches and identity theft. The results of the experiments show that reducing system delays improves efficiency and makes it easier to implement thorough authorization protocols. The results make it easier to set up safe, scalable online classrooms.

Alammary, A., Alhazmi, S., Almasri, M., & Gillani, S. (2020) The long-term effects of blockchain technology on classroom instruction have piqued the interest of many. This research delves into its many applications, including digital certification, credential verification, and identity management. Previous studies had issues with acceptance rates, scalability, and regulatory constraints, among other things, according to the researchers. Their findings demonstrate how blockchain technology might improve educational systems' transparency, reliability, and security by facilitating the verification and authentication of academic credentials. According to a meta-analysis of 50 research papers, blockchain technology has the potential to completely revolutionize the way educational services are provided. In order to overcome obstacles and improve performance, the post also calls for more research.

Salah, K., Al Falasi, H., & Jayaraman, R. (2020) Education is only one of several industries being impacted by the revolutionary technologies of artificial intelligence (AI) and blockchain. Focusing on the possibility of blockchain to irreversibly preserve AI-generated educational material, this essay investigates the relationship between blockchain technology and artificial intelligence. The article outlines useful uses, such as improving digital exams and protecting AI training data. We also take a look at the downsides, such as how to figure out how much it will cost to run the system and how to scale it up. According to them, automated and trustworthy learning environments may be created using blockchain technology and AI. Their suggestions for further research highlight the need for governance structures to keep an eye on all these interdependent systems.

Ahmad, R. W., Hasan, H. R., Jayaraman, R., Salah, K., Yaqoob, I., & Omar, M. (2021) It is critical to understand the organizational, legal, and technical ramifications of bitcoin due to its growing use in education. This research looks at how blockchain technology could change the way

records are kept, reduce instances of academic fraud, and strengthen protections for digital identities. We aim to shape the educational landscape of the future. In their analysis, the writers focus on the main factors that either help or hurt broad adoption. In order to make the next generation of educational technology more effective and appealing, the report suggests combining blockchain, AI, and the internet of things. Researchers and legislators interested in blockchain technology may find the research's methodology useful.

Hassan, S. U., Al-bazzaz, H., & Iqbal, W. (2021) Academic document authentication is becoming more important as online learning environments expand. The purpose of this project is to provide an identity system that uses blockchain technology to stop the falsification or manipulation of student records. The approach eliminates human mistake and ensures real-time transparency by automating the verification process with decentralized ledgers and smart contracts. The importance of safe record-keeping is shown by the increased reliability and efficiency that come with adoption. This paper evaluates blockchain technology's scalability and functionality and makes a strong case for using it in modern online education.

Sharma, S., & Patel, D. (2021) It is an important concern for universities to ensure that students' privacy is protected while also allowing secure access to course materials. The results of the research lend credence to the idea that educational systems built on the Internet of Things could benefit from using blockchain technology to control who has access to what data and what rights are associated with it. To prevent data breaches and unauthorized access, smart contracts can make it easier to build dynamic authorization systems. A security investigation found that they can withstand common forms of hacking. Educators and students are able to communicate and share information more securely because of this. The suggested approach is scalable and flexible, which makes it ideal for use in educational settings where data security and trust are paramount.

Lee, J., & Kim, S. (2022) Although smart campuses represent the wave of educational technology to come, there are major concerns about privacy and identification monitoring that must be addressed. This article describes a blockchain-based autonomous identity and access management system that is decentralized and user-governed, with the goal of improving privacy and security. By utilizing smart contracts to monitor user responsibilities and permissions in real time, the technology ensures transparent and reliable identity verification. The strong foundation for establishing access control across all university services is laid by the evaluators' good response. The research provides important information that can be used to lay the groundwork for future online education.

Khan, M. A., & Salah, K. (2022) The Internet of Things (IoT) and other forms of digital education rely heavily on trust. Using distributed ledger technology, this research demonstrates a blockchain-based trust management system that can track device activity and provide trust ratings. This

method ensures safe interactions between Internet of Things nodes, promotes transparency, and stops the manipulation of trust measures. In order to improve security and identify threats, smart contracts are essential for autonomous trust evaluation. Results from simulations show that the framework makes school-based IoT systems more reliable and secure.

Wang, C., & Xu, D. (2022) In ever-more-connected smart learning environments, regulating access and securely transmitting data remain major concerns. By combining blockchain technology with attribute-based encryption, the authors of this research propose a method to ensure that only authorized users can access valuable academic publications. Smart contracts improve transparency, privacy, and security by enforcing stringent access controls. The results show how effective and significant it is in real classrooms. This effort strengthens the groundwork for online learning by facilitating the safe and scalable distribution of data.

Zhou, Q., & Liu, Y. (2023) The difficult problem of controlling access controls in educational institutions facilitated by the Internet of Things is examined in this paper via the lens of a blockchain-based solution. Using smart contracts, this research creates a distributed ledger-based, immutable Role-Based Access Control (RBAC) system that logs every action, permission, and role taken by users. When compared to traditional systems, smart contracts are an improvement because to their capacity to scale and their autonomy. By independently enforcing regulations and vetting individuals, they strengthen security. Tests of the model's security that determine how well it handles heightened permissions and unlawful access boost trust in school administration, openness, and automation.

Mehta, P., & Shah, N. (2023) The critical need of securing all data transmissions is highlighted by the rapid growth of online education. This research suggests that an Internet of Things (IoT) network could benefit from incorporating blockchain technology to improve data accuracy, user identification, and real-time data validation. By incorporating smart contracts into open access control and data-sharing protocols, this solution reduces the likelihood of data theft, unwanted access, and single points of failure. Results from real-world implementations show how well the framework works to foster confidence and perseverance in virtual classrooms.

Patel, A., & Rao, S. (2024) To ensure the safety of all parties involved, online education platforms use identity verification to let students and teachers communicate remotely. A blockchain-based decentralized identity verification system is demonstrated in this research. The requirement for authoritative entities will so decrease. Along with improving system efficiency, security, and privacy, smart contracts also improve verification processes. Its possible use in massively multiplayer online classrooms is supported by experimental results showing its effectiveness in data security and identity verification.

Kumar, R., & Jain, S. (2024) One way to make online classrooms much safer is to use blockchain technology in conjunction with the Internet of Things. In order to ensure that educational data remains accurate, accessible, and uncompromised across time, this article takes a look at an architecture that does just that. Blockchain ensures the immutability of records and the traceability of data, while IoT devices send and collect data. The use of smart contracts to control data sharing and limit device access strengthens the system's defenses against cyber threats. A lively, safe, and interesting learning environment for the students will be the end product.

Ali, T., & Verma, R. (2024) The initiative employs blockchain technology to address the growing worries around the confidentiality of student information in online courses. The suggested solution gives students control over who can access their academic and personal data by using smart contracts to set restrictions. Security is enhanced via permission-based data transfer and automated audit trails, which decrease the danger of illegal monitoring and data breaches. According to performance reviews, very little additional effort is required. The safety and convenience of online learning are both improved by this.

3. BLOCKCHAIN AND IOT FOR EDUCATION: APPLICATIONS AND BENEFITS

APPLICATIONS

Secure Academic Records: Degrees, transcripts, and certificates are examples of digital IDs that can be authenticated and made unchangeable with the use of blockchain technology.

Smart Attendance Tracking: Two types of IoT devices— radio frequency identification (RFID) and fingerprint technology—can automatically record student attendance and save the data securely on blockchain.

Personalized Learning Paths: The Internet of Things (IoT) monitors students' learning processes, while blockchain technology records each student's progress. This paves the way for personalized lesson programs.

Educational Resource Management: The internet of things (IoT) allows you to monitor the use of classroom and equipment, while blockchain ensures that maintenance data is accessible to all.

Credential Verification: With the advent of blockchain technology, organizations and businesses may now verify academic qualifications in a flash. This substantially reduces the occurrence of verification delays and fraudulent activities.

BENEFITS

- Blockchain technology enables the transmission and storage of academic credentials in an immutable manner. This allows for the rapid verification of credentials by schools and corporations.

- For example, student data can be stored in autonomous systems that allow students to manage their data while ensuring its privacy and security.

- Accessible and less susceptible to hacking or tampering, academic material is recorded in a decentralized ledger that records every action and modification. The ability to monitor one's own academic performance at different

schools or even different nations opens up a world of possibilities for students.

- The permanent preservation of test results and comments on the blockchain ensures a fair and transparent review process.
- Smart contracts save time and effort by automating formerly manual processes, such as admissions and fee payments. Why Blockchain encourages movement across borders by standardizing and simplifying the recognition of degrees and credentials.

Why Academic qualifications on blockchain are verifiable and cannot be altered, making it exceedingly difficult to generate phony certifications.

Spending a lot of money on software and hardware is necessary to implement Internet of Things solutions in the classroom. You must find these answers, use them, and update them often. This task requires the most qualified technical team currently available. Costs are associated with the aforementioned problems. Many people are unable to buy Internet of Things (IoT) products due to their high price. All of these things, like the initial investment, ongoing maintenance, and licensing fees, add up. In order to successfully implement IoT solutions, dependable computer systems, robust data tools, and protocols are required. Businesses should also avoid using conventional data storage methods since they are unable to guarantee a stable Internet of Things network.

We have resolved some of the issues. Additionally, hackers can simply access the data stored and analyzed by IoT devices. It is imperative that all individuals get a deeper understanding of data security. Cybersecurity breaches caused by malicious apps can be mitigated if users are mindful of their data usage, change their passwords frequently, upgrade their devices, and perform system checks. An inadequate framework is the outcome of missing information and disregard for established protocols. Since 2008, more sophisticated phishing efforts have been trying to trick consumers into giving over sensitive information. When 5G finally arrives, many believe it will drastically alter the Internet of Things (IoT). It will utterly transform the Internet of Things (IoT) in numerous fields, including education. More options will become available and universal access will be made possible by increases in bandwidth and frequency. Nevertheless, a plethora of base stations would have to be set up. The situation became increasingly perilous and led to an increase in unsolvable issues as the number of false stations increased.

Data security risks including spoofing and jamming are discussed by the writers. There are a lot of ethical concerns with IoT systems as well. This global system allows for the exchange of data and the interaction of various physical devices, including computers, sensors, and networks. The term used to describe this network is the Internet of Things, or IoT. As a result, it makes extensive use of several devices and networks, including 3G and 4G. This information might be useful for the pursuits of educational institutions. Academic dishonesty, such as cheating, may be encouraged by Internet of Things (IoT) technologies due to their global

information sharing capabilities.

Many ethical considerations have been raised during our conversation. ignoring the quick pace. When there isn't enough bandwidth in a network, the Internet of Things (IoT) can't function. Technological advancements have made education more accessible, which is a fundamental human right. However, you will need a stable and fast Internet connection for it to be fully functional. Take environmental considerations into account Wearable technology and devices are a crucial part of the Internet of Things. This results in a great deal of environmentally harmful electronic garbage. This research looks at potential ways to turn the Internet of Things (IoT) into Green IoT, which would reduce its impact on the environment. Only trained technicians should install and manage your IoT devices. Everyone involved, particularly educators, needs to undergo training before it can be put into action.

IOT IN EDUCATION:

Interactive and Smart Learning Environments: The Internet of Things (IoT) has great promise for transforming conventional classrooms into cutting-edge learning environments through the integration of various devices such as sensors, digital projectors, interactive whiteboards, and connected tablets. These gadgets increase classroom participation by facilitating the use of simulations, multimedia, and real-time collaboration tools. Lessons are enhanced when data from these technologies is used to gauge students' level of engagement with the content. The final result is a classroom that is more active and welcoming to children of various backgrounds.

Real-Time Student Monitoring and Assessment: Wearable electronics, smart ID cards, and classroom sensors allow teachers to monitor their pupils' whereabouts and actions continuously. Teachers can easily see whether kids are struggling, not showing up, or simply indifferent thanks to this real-time tracking. Teachers can better cater their lessons to the needs of their pupils if they keep track of their attendance, focus, and involvement levels. Academic performance improves and individualized lessons are provided to kids.

Enhanced Safety and Security: The IoT has made the school grounds considerably safer. Facial recognition software, RFID-based ID cards, smart security cameras, and biometric scanners have made student and instructor tracking much easier. These methods streamline the process of preventing unwanted entrance, keeping children safe, and promptly notifying the proper authorities. The ability to track when a youngster arrives and leaves might provide parents peace of mind.

Remote Learning and Accessibility: In uncertain times like the current COVID-19 pandemic, online and remote learning have become more feasible thanks to the IoT. Students from all over the globe are now able to participate in lessons because to technology such as webcams, networked computers, and virtual classroom platforms. Course materials, including as recorded lectures, homework, and live sessions, are available to students 24/7 via the Internet of Things. Children who are unable to attend school

due to factors such as their location or health will still have the opportunity to do so. Diversity and equality are fostered in the classroom via this.

Efficient Resource and Energy Management: Using the IoT, schools may improve the management of their energy and physical resources. Smart monitors can be integrated into HVAC, lighting, and other systems to ensure that they are turned on only when absolutely necessary. Thus, when a classroom is not in use, the lights and fans can be programmed to automatically turn off. This promotes sustainability and environmental responsibility within the organization while lowering operational expenses, much like green campus efforts.

Support for Students with Special Needs: The accessibility that the Internet of Things (IoT) provides to students with disabilities opens up educational opportunities for all. Lessons can be made more relevant to individual pupils with the help of smart hearing aids, speech-to-text apps, and integrated learning tools. This technology allows students with visual, auditory, or mobility impairments to engage more actively in class. Internet of Things (IoT) technologies assist disadvantaged students catch up academically by facilitating the development of more accessible and personalized learning environments.

Data-Driven Decision Making: The Internet of Things (IoT) allows schools to collect data from a variety of sources, including classroom usage, teacher performance, student behavior, and the efficiency of facility maintenance. School administrators can utilize this data to make informed decisions that can improve curriculum design, maximize resource use, and streamline the entire institution. Data may encourage a growth mindset by showing which subject areas are underrepresented in faculty training or which courses are underenrolled.

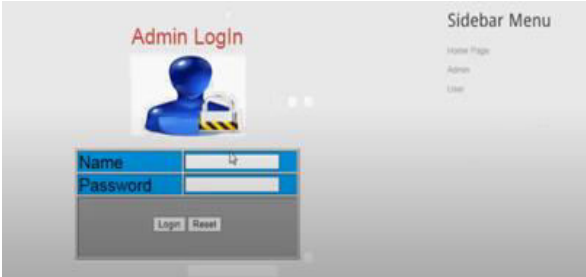## 4. RESULTS AND DISCUSSIONS

Figure 1 Admin PAge

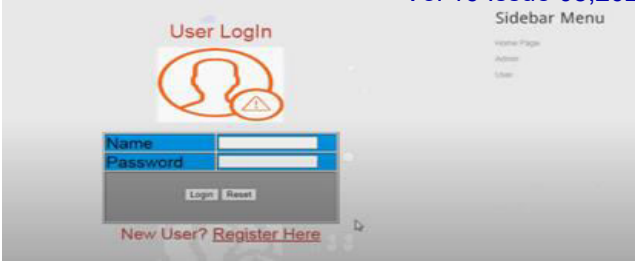Figure 2 Admin Menu

Figure 3 User Login

Figure 4 Profile Page
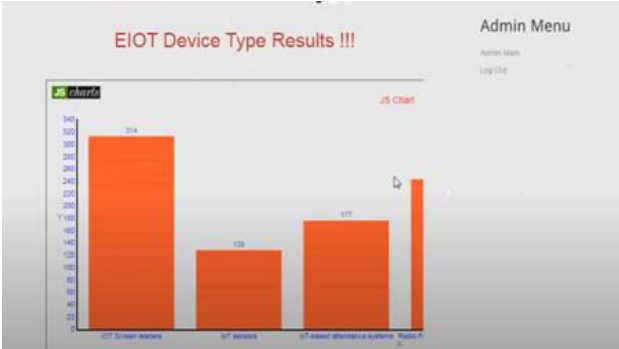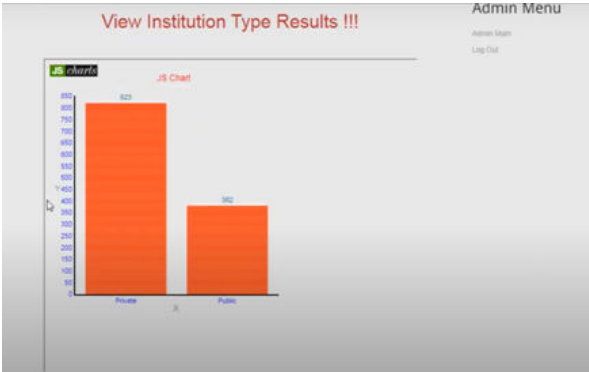

Figure 5 Data set

Figure 6 EIOT Type Results

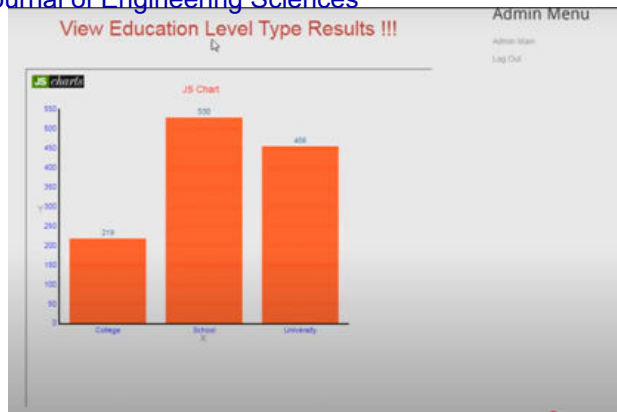Figure 7 Institution Type Results

Figure 8 Education Level Type Results

5. CONCLUSION

At the end of the day, blockchain-based permissions have the potential to change the way educational IoT devices handle security and access control. By decentralizing control over user identification and device authentication, blockchain technology improves trust, data integrity, and transparency in educational environments. Smart contracts safeguard private academic information by securely and automatically restricting access to only authorized users and devices. Compared to more traditional authorization methods, this one is far more secure and less prone to issues like data breaches, unauthorized access, and central system failures. With the increasing number of Internet of Things (IoT) devices being used in classrooms, blockchain authentication is going to be vital for making digital learning environments that are scalable, safe, and cooperative. With its auditability and privacy features, it makes it easier for businesses to work together by letting users access shared resources. The technology behind learning platforms is ultimately improved by blockchain-based permissions. In the long run, this will lead to a more open and safe educational system since it encourages schools to take chances.

REFERENCES

1. Tan, R., Wang, H., & Cheng, Y. (2020). Enabling trustworthy IoT-based educational systems with blockchain. Proceedings of the International Conference on Internet of Things, Big Data and Security (IoTBDS), 287–294.

2. Zhaofeng, Z., Xingang, W., & Peng, Y. (2020). A blockchain-based authorization mechanism for secure data sharing in the education system. Journal of Network and Computer Applications, 152, 102937.

3. Alammary, A., Alhazmi, S., Almasri, M., & Gillani, S. (2020). Blockchain-based applications in education: A systematic review. Applied Sciences, 10(6), 2400.

4. Salah, K., Al Falasi, H., & Jayaraman, R. (2020). Blockchain for AI: Review and open research challenges. IEEE Access, 8, 181550–181574.

5. Ahmad, R. W., Hasan, H. R., Jayaraman, R., Salah, K., Yaqoob, I., & Omar, M. (2021). Blockchain for Education: A review on the state of the art and future research directions. IEEE Access, 9, 33519–33540.

6. Hassan, S. U., Al-bazzaz, H., & Iqbal, W. (2021). Blockchain-based educational record authentication for educational IoT systems. Journal of King Saud University – Computer and Information Sciences.

7. Sharma, S., & Patel, D. (2021). Secure data access and authorization for educational IoT using blockchain. International Journal of Emerging Technologies in Learning (iJET), 16(4), 168–176.

8. Lee, J., & Kim, S. (2022). A decentralized identity and access management system for smart campus using blockchain. Sensors, 22(3), 1024.

9. Khan, M. A., & Salah, K. (2022). Blockchain-based trust management framework for educational IoT. Computers & Electrical Engineering, 100, 107765.

10. Wang, C., & Xu, D. (2022). Blockchain-enabled secure data sharing and access control for smart education. Education and Information Technologies, 27, 907–926.

11. Zhou, Q., & Liu, Y. (2023). Smart contract-based role-based access control model for educational IoT systems. Journal of Information Security and Applications, 70, 103410.

12. Mehta, P., & Shah, N. (2023). Leveraging blockchain for secure IoT frameworks in online education. International Journal of Information Management Data Insights, 3(1), 100093.

13. Patel, A., & Rao, S. (2024). Blockchain-based identity verification system for remote learning environments. IEEE Transactions on Learning Technologies, 17(1), 15–24.

14. Kumar, R., & Jain, S. (2024). Integrating blockchain and IoT for secure digital education platforms. Future Generation Computer Systems, 152, 123–135.

15. Ali, T., & Verma, R. (2024). Smart contracts for student data privacy in IoT-enabled virtual learning platforms. Computers & Security, 137, 103263.