

A Review of Blockchain Technology in storing Critical documents

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Abstract: Blockchain technology has recently attracted a lot of interest from academics and professionals. Its special attributes, including as scalability, security, dependability, and integrity of information, are mostly to blame for this. Despite this growing interest, little is known about the status of current knowledge and application regarding the use of blockchain in educational scenarios in India. This article is a comprehensive analysis of studies looking into blockchain-based educational reviews from various studies. It focuses on three key topics: (1) educational data created using blockchain technology; (2) advantages for education; and (3) difficulties in implementing blockchain technology in India's educational system. Each theme's results were thoroughly examined, and there was a thorough discussion based on the findings. Also in this review provides information on additional subject areas for training in India that could profit from blockchain technology.

Keywords: Decentralized Systems, Blockchain Use cases, document storage, Blockchain Technology

1. Introduction

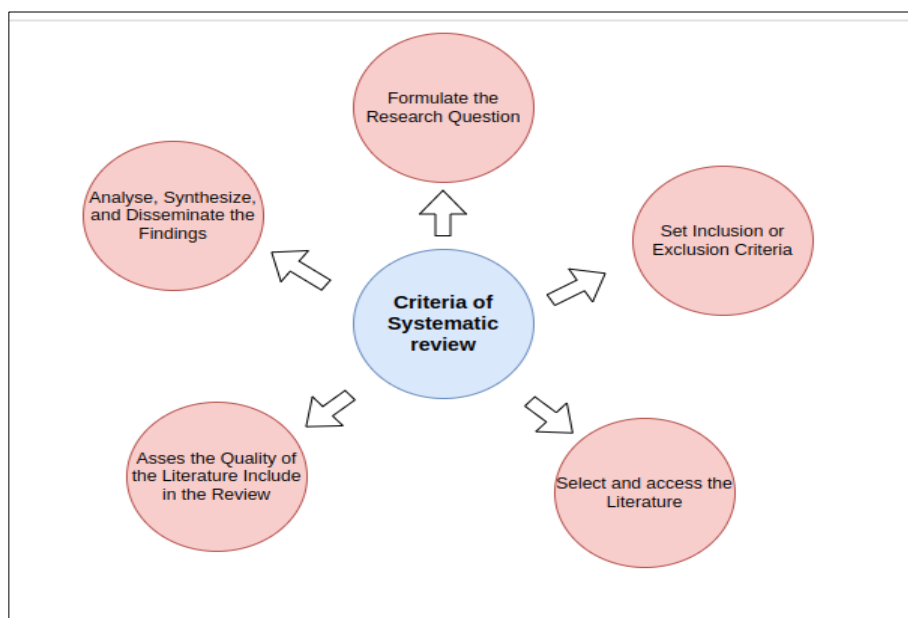
Blockchain is a new innovation that was first launched in 2008. It was initially employed as a peer-to-peer database for recording Bitcoins digital currencies. The intention was to remove all third-party mediators and enable users to conduct transactions directly. Blockchain was created as a decentralized system of peer nodes to do that. Each network performs the following functions: (1) maintains a copy of the transaction ledger; (2) adds an entry to its ledger when it receives consensus from the other nodes; (3) broadcasts any transaction made by its user to the other nodes; and (4) periodically verifies that the ledger it maintains is the same as those held by other nodes.

2. Literature Review

Blockchain is the basic technology used to create the cryptocurrency, Bitcoin, by maintaining a consistent distribution of thousands of nodes proposed by Satoshi Nakamoto in 2008 (Nakamoto 2008). It is considered to be part of the fourth industrial revolution since the introduction of steam engines, electronics, and information technology (Chung and Kim 2016; Schwab 2017). These disruptive technologies will have a profound impact on national

governance, institutional activities, business operations, education, and our daily lives in the 21st century.

Figure 2.1
Criteria of Review



(Source: <https://www.researchgate.net/profile/Muhammad-Ramdhani9/publication/311735510/figure/fig1AS:445939564453888@1483331685306/Criteria-used-to-systematic-review.png>)

This section covers some fundamental ideas and theories from prior research on the block chain and its various real-world applications in the realm of education. It also contrasts the results of the current other investigations. This section gives detail summary of various previous discussions on related work of missing data indicated in various different researches.

According to **Jasmeet Kaur, Jyotsna (2020)**¹ studied and discussed about blockchain and it is in education in its initial stages, number of IT based organisations aims at providing the solutions to Education industry. According to whitepaper, IBM's work in education and blockchain to transform education by solving problems and bringing the stakeholders on a single BCT platform.

Also, **Bhanu Prakash kolla, y v r naga pawan (2020)**² described Tertiary Education and it is expanded exponentially over a decade, in India. The statutory authorities are striving for inducing the quality in tertiary education through Outcome Based Education as one of the major transformations. The phoney credentials are culminating the initiatives and affecting the right spirit of transformation initiatives.

Furthermore, **Timothy Arndt and Angela Guercio (2020)**³ introduced a study on Blockchain and has emerged as a transformative technology, from its beginning as the basis of cryptocurrencies to wider applications in areas such as property registration and insurance due to its characteristic as a distributed ledger which can remove the need for a trusted third party to facilitate transaction.

Manoharan Ramachandran, Niaz Chowdhury, Allan Third, Zeeshan Jan, Chris Valentine, and John Domingue(2020)⁴ have reviewed The Internet of Things (IoT) has emerged as a disruptive technology in recent time. Due to a sharp rise in the deployment of IoT devices across the globe, the total amount of generated data reaching record highs every day. There is no denying that IoT devices with the data that they produce enhancing our day to day lives by bringing in innovative solutions.

According to **Niti Aayog(2020)⁵** have explained the first part of the strategy titled “Blockchain: The India Strategy Towards Enabling Ease of Business, Ease of Living and Ease of Governance”, aims to address these needs. The paper first analyses the value of blockchain in facilitating trust in government and private sector interactions, followed by considerations when evaluating a blockchain use case for implementation, possible challenges and lessons from NITI Aayog’s experiences in blockchain implementation showcases potential use cases that the ecosystem may consider.

Ms. Smita Mehendale, Dr. Aakash Kamble(2019)⁶ evaluates about Blockchain technology aides in student wisdom and motivations. Records of educational activities and outcomes are stored in a trustworthy manner considering both the formal as well as informal learning environments. Teacher’s records relating to the behaviour and performance are also maintained thus helping in teaching evaluation. Also discussed for both the parties, the learners and teachers have access to the information and the processes followed during the curriculum.

Palanivel Kuppusamy(2019)⁷ discussed the blockchain is an emerging technology that serves as an immutable ledger, which allows transactions to take place in a decentralized manner. He also discussed the It has become a publicly available infrastructure for building decentralized applications and achieving interoperability. Blockchain-based applications ensure transparency and trust between all parties involved in the interaction. He also explains that the blockchain also makes blockchain technology-based services interest to the education sector. Nowadays, educational organizations focus on online education.

Md Moniruzzaman, Abdulsalam Yassine, Rachid Benlamri (2019)⁸ focused the dramatic increase in blockchain technology has provided many new application opportunities, including healthcare applications. This survey provides a comprehensive review of emerging blockchain-based healthcare technologies and related applications. In this inquiry, we call attention to the open research matters in this fast-growing field, explaining them in some details. They also show the potential of blockchain technology in revolutionizing health care industry.

Vipul H. Navadkar , Ajinkya Nighot , Rahul Wantmure (2018)⁹ have done a review and survey on blockchain technology and our perception about trusting records. They don’t have to rely on trusted third parties, like government registry. Its developing in still many applications and its does have its own opportunities and risks. There will a way connecting market managers and blockchain enterprises with each other. Together they can implement blockchain on various platforms and introduce innovative solution.

Muhamed Turkanović, Marko Hölbl, Kristjan Košič, Marjan Hericko (2017)¹⁰ explored the major troubles of Blockchain technology and the creation of a decentralized environment where transactions and data are not under the control of any third party organization. Any transaction ever completed is recorded in a public ledger in a verifiable and permanent way. Based on blockchain technology, we propose a global higher education credit platform, named EduCTX. This platform is based on the concept of the European Credit Transfer and Accumulation System (ECTS).

Table 2.1*Related Papers Review Table*

NO	PUBLICATION	YEAR	TITLE	AUTHORS	DESCRIPTION
1	International Journal of Advanced Computer Science and Applications	2021	Blockchain Technology in Education System	Afnan H. Alsaadi, Doaa M. Bamasoud	The aim of this paper is to review the blockchain technology and its benefits in relations to education system. Blockchain technology is widely researched and highly evaluated and appraised for its unique infrastructure. In general, blockchain researched for its association with Bitcoin and cryptocurrency advantages. In this survey the plan is to conduct a full review of previous literature focused on blockchain in education systems. Provide overall reviews of blockchain concepts and architecture behind the technology and to examine verification software that used by the technology to improve security and immutability.
2	Cross-Currents: An International Peer-Reviewed Journal on Humanities & Social Sciences	2024	Blockchain Technology in Education: Applications and Challenges	Dr. Karamjeet Kaur	Blockchain technology has emerged as a transformative tool with the potential to revolutionize various sectors, including education. This research paper explores the applications of blockchain technology in the education sector, highlighting its rationale, challenges, and prospects. By leveraging blockchain's inherent properties of decentralization, immutability, and transparency, educational institutions can enhance data security, streamline administrative processes, and ensure the authenticity of academic credentials. The benefits of blockchain are multifaceted and might be beneficial to educational institutions and students. However, the adoption of blockchain technology is

					presently in its incipient stage within the educational sector.
3	SHS Web of Conferences	2024	Research on student records management system based on blockchain		Through the analysis of the current problems found in the management of student records, it is found that the feasibility and necessity of applying blockchain technology to student records. Starting from the needs of school record management, we build the overall framework of electronic school record file block chain system, and design the operation process of school record file block chain management system. In order to realize the integrity, confidentiality and support of confidential data sharing, the alliance chain is adopted to further realize the layered architecture of the block chain, and the architecture of the block chain system of the electronic school records is designed.
4	Jac:a journal of composition theory	2020	A Review of Blockchain Technology in Education	Jasmeet Kaur, Jyotsna	This research paper contains blockchain and it is about in education is in its initial stages,number of IT based organizations aims at providing the solutions to Education industry.
5	Journal of Engineering Education Transformations	2020	Blockchain for Tertiary Education	Bhanu Prakash kolla ,y v r naga pawan	This article contains Tertiary Education and it is expanded exponentially over a decade, in India.
6	International Journal of Information and Education Technology	2020	Blockchain - Based Transcripts for Mobile Higher-Education	Timothy Arndt and Angela Guercio	This research represents about Blockchain and it has emerged as a trans formative technology, from its beginning as the basis of crypto currencies to wider applicationsin areas such as property.
7	International	2020	A	Manoharan	This article about the

	Journal of Information and Education Technology		Framework for Handling Internet of Things Data with Confidentiality and Blockchain Support	Ramachandran, Niaz Chowdhury, Allan Third, Zeeshan Jan, Chris Valentine, and John Domingue	Internet of Things (IoT) has emerged as a disruptive technology in recent time.
8	The Open University's repository of research publications and other research outputs	2020	Blockchain :The India Strategy	Niti Aayog	This research explains about blockchain in the India Strategy and it towards Enabling of Ease Business, Ease of Living and Ease of Governance, aims to address these needs explains. The paper first analyses the value of blockchain .
9	Journal of Xi'an University of Architecture Technology	2019	Blockchain: The India Strategy	Ms.Smita Mehendale, Dr. Aakash Kamble	This research about Blockchain technology and it aides in student wisdom and motivations. Records of educational activities and outcomes are stored in a trustworthy.
10	Journal of Xi'an University of architecture & Technology Vol: XI, Issue:xii, Pahe No: 1206- 1213	2019	Trust the System Blockchain Technology and its Application in Education	Pal anivel Kuppusamy	This paper explains about blockchain and it is an emerging technology that serves as an immutable ledger which allow transactions to take place in a decentralized manner
11	International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)	2019	Blockchain Architecture to Higher Education Systems.	Md Moniruzzaman, Abdulsalam Yassine, Rachid Benlamri	This article focused the dramatic increase in blockchain technology and about p rovided many new application in blockchain methods.
12	irjet(International journal of Engineering and Technology)	2018	Blockchain Architecture to Higher Education	Vipul H.Navadkar, Ajinkya Nighot, Rahul	This paper about review and survey on blockchain technology and various perception about

			Systems.	Wantmure	trusting records in block chain
13	Ieeexplore Vol: 06, Page No: 5112- 5127	2017	EduCTX:A Blockchain- Based Higher Education Credit Platform	Muhammed Turkanović, Marko Hölbl, Kristjan Košič, Marjan Hericko	This research explored the major troubles of Block chain technology and the creation of a decentralized.
14	Congress in Computer Science, Computer Engineering, & Applied Computing (CSCE)	2023	Blockchain Technology in Education: A Comprehen sive Review in Transparenc y	Younghun Chae	Blockchain technology offers significant potential to transform the education sector. This paper systematically reviews blockchain's role in education, focusing on its transparency ability. It investigates how blockchain could revolutionize education, from data management to credential verification, and identifies data privacy, scalability, legal issues, and more challenges. The paper aims to contribute to the current body of knowledge, fill existing research gaps, and guide future studies in this promising area
15	International Conferences on Information System and Technology (CONRIST 2019)	2020	A Proposed Model of Secure Academic Transcript Records with Blockchain Technology in Higher Education	Meyliana, Yakob Utama Chandra, Cadelina Cassandra, Surjandy , Erick Fernando , Henry Antonius Eka Widjaja and Harjanto Prabowo	This article explains how higher education institutions use blockchain technology that is able to maintain data security and prevent data manipulation, especially in academic transcript files. Academic transcript records become an output from students after completing a semester or level of education at the higher education institution. In general, academic transcript records are used when students complete a study at a higher education institution as a document requirement for access to the company where they work. Thus academic transcript reports become important for companies to find out if this student is competent in a certain

					area.
16	Blockchain: Research and Applications	2023	Unlocking the power of blockchain in education: An overview of innovations and outcomes	Amr El Koshiry, Entesar Eliwa, Tarek Abd El-Hafeez, Mahmoud Y.Shams	This study is the need to address the challenges in fully realizing the potential of blockchain technology in the education sector. While the potential benefits of blockchain in education are significant, the abstract mentions several challenges that need to be addressed, such as adoption, technical knowledge, interoperability, regulation, cost, data privacy and security, scalability, and accessibility. These challenges can hinder the implementation of blockchain technology in education and prevent it from improving the efficiency, security, and credibility of the educational process. Therefore, the overview aims to provide an understanding of how blockchain technology can potentially revolutionize the education sector, its potential benefits, and the challenges that must be addressed to fully realize its potential.
17	Evolutionary Intelligence	2023	The application of blockchain algorithms to the management of education certificates	Raúl Jaime Maestre, Javier Bermejo Higuera, Nadia Gámez Gómez, Juan Ramón Bermejo Higuera, Juan A. Sicilia Montalvo & Lara Orcos Palma	This solution, the development stages of the platform, the system architecture, and the operation of the API have been carried out, resulting in a platform that constitutes the first step towards a more transparent and technologically advanced way of managing the certifications of the students' qualifications.

3. Use Case

The use of blockchain for storing academic transcripts offers a secure and efficient way to manage educational credentials. Blockchain ensures data integrity by hashing transcripts, creating a unique digital signature that prevents tampering. This hash, along with metadata like the issuing institution's details and timestamps, is stored on the blockchain. Students are given access keys to securely share their credentials with potential employers or institutions. Verifiers can confirm the authenticity of a transcript by comparing its hash with the blockchain record, eliminating the risk of forgery.

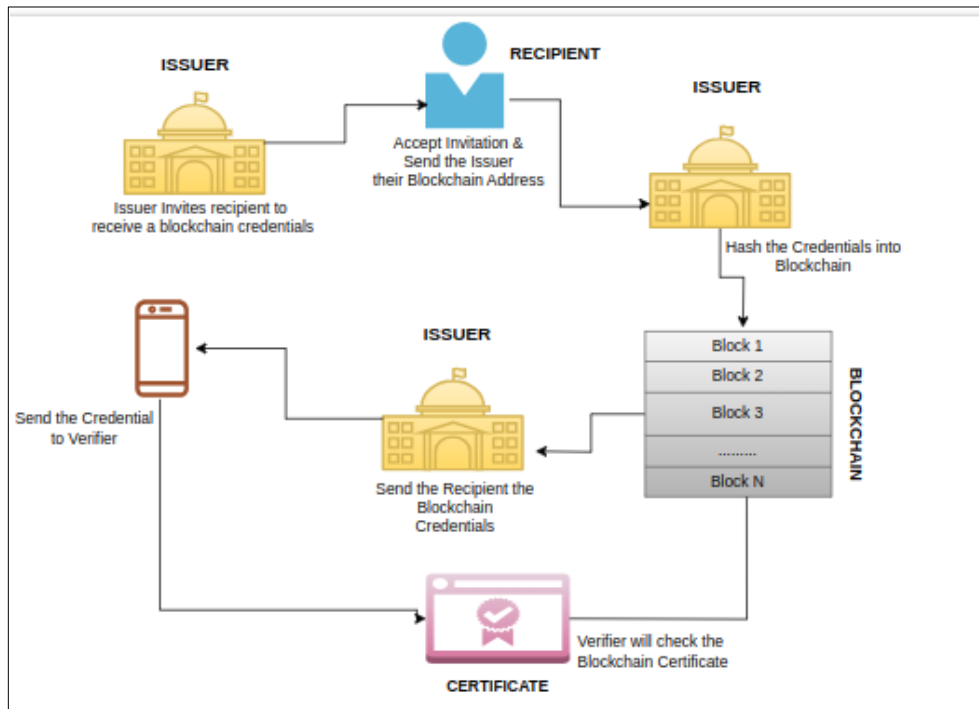
This approach provides significant benefits, including enhanced security, reduced administrative costs, and greater transparency. It also empowers students by giving them control over their records and ensures faster verification processes for employers. Additionally, blockchain's decentralized nature minimizes reliance on central authorities, making it resilient against data breaches and manipulation.

- **Immutability:** Blockchain ensures that transcripts cannot be altered once stored.
- **Transparency:** Both students and institutions can verify records at any time.
- **Decentralization:** Removes reliance on a single entity to maintain records.
- **Verification:** Employers and other institutions can instantly verify the authenticity of transcripts.
- **Ownership:** Students have control over their academic credentials and can share them securely.

4. Workflow

- **Issuance:**
The educational institution creates a transcript for a student.
The transcript is hashed (converted to a unique digital fingerprint) for privacy and security.
The hash is stored on the blockchain.
- **Storage:**
The blockchain stores the transcript hash, timestamp, and metadata (e.g., student ID, institution details).
- **Access:**
Students receive a key or a digital wallet to access their transcripts.
They can share access with employers or other institutions.
- **Verification:**
Employers or institutions verify the transcript by checking the hash on the blockchain against the provided transcript.
If the hashes match, the transcript is verified as authentic

Figure 4.1
Use Cases



(Ref: [https://www.researchgate.net/profile/Tanweer-Alam-](https://www.researchgate.net/profile/Tanweer-Alam-2/publication/341193934/figure/fig4/AS:888308745895936@1588800717382/Working-process-of-Blockcerts-Application.ppm)

[2/publication/341193934/figure/fig4/AS:888308745895936@1588800717382/Working-process-of-Blockcerts-Application.ppm](https://www.researchgate.net/profile/Tanweer-Alam-2/publication/341193934/figure/fig4/AS:888308745895936@1588800717382/Working-process-of-Blockcerts-Application.ppm))

Figure 4.2
Existing Use Cases

	Institutions	Blockchain	Network type	Consensus algorithm	Type of consensus
Certiblock	UNIR	Ethereum	Public	Proof of Work (PoW)	Proof of work (51%)
OpenDCert	UOC	Rinkeby	Public	PoW	Proof of work (51%)
Blockchain for Education	Fraunhofer, University of Luxembourg	Ethereum	Permitted Private	– *	– *
Blockcert	MIT, University of Nicosia, University of Birmingham, South Ural State University, University of Rome and University Fernando Pessoa	Ethereum, Hyperledger, Bitcoin	Public Permitted Private	Proof of Authority	– *
BeCertify	IEBS Business School	Europe Chain	Permitted Private	PoW	Proof of work (51%)
CRUE	Jaén Univ., Extremadura Univ., etc	BLUE	Permitted Private	– *	– *
SmartCert	University of Al- Zaytoonah	Ethereum	Public	– *	– *
Smartdegrees	Carlos III Univ	Quorum	Permitted Private	QuorumChain	Red T: QuorumChain Red B: PoW, PoA e IBFT
Chain Talent	CEU	Red T: Quorum Red B: Hyperledger Besu	Permitted Private	Red T: QuorumChain Red B: PoW, PoA e IBFT	Red T: Majority vote (BFT / RAFT) Red B: Proof of work (51%), etc
EduCTX	University of Maribor BRNO University of Technology, Sarajevo University	ARX	Public	Proof-of-Stake (PoS)	Distributed PoS

(Ref: <https://link.springer.com/article/10.1007/s12065-022-00812-0/tables/1>)

5. Discussion

Blockchain is the technology that has applications in numerous fields and specifically in the field of education it is still unexplored as the technology is relatively new. This review included various research papers, white papers and articles searched in electronic databases using different keywords. The conclusion provides a summary of findings about block chain prototyping for better security of data in education in Indian scenarios. The currency properties of this technology initiate many inventive and potential applications for the education sector. Based on the concept shared in an earlier section. For the researchers, the potential of Blockchain technology can be explored and applied in relatively the education area. The research in this area is far and few. The smart contract ensures the learning activities are verifiable, robust, and traceable. Furthermore, the institutes, colleges and universities must be ready to embrace the ever-expanding scope of Block chain technology.

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