



BLOCKCHAIN IN EDUCATION

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Abstract : This paper focuses on blockchain's educational applications and argues that it may be applied to address certain issues in the field of education. Numerous businesses and academic institutions in Europe and beyond are becoming more interested in blockchain. Blockchain is revolutionary tech that is relatively new development in computer science. It is expected to drive the expansion of the global economy for the foreseeable future. The distributed ledger technology of blockchain can significantly and favorably affect the accountability and transparency of the education sector. This article primarily focuses on how blockchain is playing a significant role in the education industry and some real-world use examples from students and instructors.

IndexTerms - Blockchain, Education Sector, Digital Certificate, Security, Privacy, Education Language Learning, Decentralized Systems.

I. INTRODUCTION

A few years ago, the word "blockchain" wasn't widely used. Despite the fact that there have been blockchain trials since the early 1990s, it wasn't until Satoshi Nakamoto published a white paper in 2008 that blockchains really began to gain traction in any other industry. It was most frequently used in the financial industry. Digital currency and blockchain technologies are sometimes used interchangeably. We may use blockchain in a variety of industries, including education, healthcare, and business, as it is now more secure. Thanks to it, our data is protected even when utilising a public network. In the education sector, blockchain technology can offer free, universal access to study resources like notes and textbooks. Blockchain also enables distant students to take classes and exams digitally and professors to grade students directly on the blockchain. Blockchain intends to enable unaltered sharing and recording of digital information [2]. Immutable ledgers, or records of transactions that cannot be altered, deleted, or destroyed, are built on a blockchain. Because of this, blockchains are also known as distributed ledger technologies (DLT). Blockchains differ from conventional databases in that they store data in blocks that are then linked together using cryptography.

II. LITERATURE SURVEY

Ali Alammary et al. [1] stated in their paper thorough analysis of the literature on blockchain educational applications. Each theme's results were thoroughly examined, and there was a thorough discussion based on searching. This assessment also provides information on other subject areas in education that might gain from blockchain.

Mara Florina Steiu [2] given in the paper, the advantages and disadvantages of using blockchain technology in the field of education. The digitization and decentralization of educational credentials, as well as the promotion and encouragement for ongoing learning, are the main blockchain uses in education that have been considered.

Edward Guustaaf et al. [3] stated in paper, "Blockchain-based Education Project", This paper's goal is to analyses numerous blockchain-based higher education programmes while concentrating on the protocol utilized in this project. To improve the use of the tech in the field of education system by utilizing the blockchain feature, research will be done on the services that will be provided by current educational projects as well as the blockchain features that are now in use.

Qurotul Aini et al. [4] given in the paper, one organization that is knowledgeable about the advantages and incredible potential of blockchain is the education domain. In the context of digital archiving, a digital signature certificate is crucial, among other things, to confirm the legitimacy of a document in a school. But because there is a lack of information in the community, many are unaware of the benefits of utilizing blockchain in the field of education system. As a result, ontology is bundled on the education shutter in order to provide the general public a better knowledge of the blockchain. This research is specifically investigating the root merkle ontology approach in order to provide answers to the use of blockchain, including sluggish processes and limited storage capacity.

PATRICK OCHEJA et al. [5] given in the paper, the study offers an alternative perspective by conducting a quantitative and qualitative bibliometric examination of the research on blockchain in education, along with real-world case studies that can help shape its future adoption. This analysis's findings offer helpful information on important authors, significant articles, regional differences, bibliometric trends, hot themes, and developing fields. Reviewing 47 carefully chosen publications that addressed particular topics in education blockchain research (milestone articles) and continued to serve as an inspiration for additional work is how the qualitative analysis is conducted. The findings point to a widespread trend in blockchain education that places a greater emphasis on credentials. Additionally, it shows that uniformity remains a challenge despite the disproportionate emphasis on reporting and confirming academic credentials, and that it is not included in the majority of studies on blockchain in education.

Bushra Hameed et al. [6] given in the paper, this section of the essay emphasizes several key characteristics of blockchain technology and presents a few concepts and theories linked to recent research on blockchain-based educational projects. A blockchain is, in its most basic definition, an immutable record of data that, once it is added to a blockchain housed on a decentralised network, cannot be modified. It is virtually impossible to alter and update the records on all network objects because each record is handled by a set of independent nodes. These Nodes all begin the process by creating the blocks. Each node on the network verifies a block's integrity by hashing it.

Dr. Ritu Sharma et al. [7] stated that by maintaining a constant distribution of thousands of nodes as stated by Satoshi Nakamoto in 2008, blockchain is the fundamental technology used to establish the cryptocurrency, Bitcoin (Nakamoto 2008). Since the development of electronics, information technology, and steam engines, it is seen as a component of the fourth industrial revolution (Chung and Kim 2017). The government of our country, institutional activities, economic operations, education, and our daily lives will all be significantly impacted by these disruptive technologies in the twenty-first century. It can transform the current Internet from a "Internet of Information" to a "Internet of Value Exchange." Blockchain technology has the potential to drastically alter economic, industrial, and educational sectors while also accelerating the global transition to a knowledge-based economy.

FRIDAY J. AGBO et al. [8] This report gives a new viewpoint: a bibliometric overview of the research on blockchain with practical case studies that can influence future adoption. The outcome from this research provides important information on milestone articles, key authors, differences across countries, bibliometric trends, hot themes and developing fields. Reviewing 47 publications that addressed particular topics in education blockchain research and continued to serve as an inspiration for new initiatives is how the qualitative analysis is conducted.

Shadab Alam et al. [9], stated in the paper "A Blockchain-based framework for secure Educational Credentials", that Blockchain offers a novel method for handling chores, carrying out transactions, and establishing trust. Blockchain is viewed by some as a ground-breaking technology for cybersecurity and cryptography, having uses in everything from cryptocurrencies to healthcare, smart contracts, the Internet of Things, and smart grids. The supplier chain, governance, etc. This study would provide a thorough examination of blockchain security, privacy, and trust. It investigates the problems and additional uses of blockchain technology in the field of education. It also suggests a blockchain-based structure for managing student records that is trustworthy and secure.

Abdulghafour Mohammad et al. [10], given in the paper, "Challenges of Using Blockchain in the Education Sector: A Literature Review", The goal of this study was to evaluate previously written publications that covered the difficulties in using blockchain in the education industry. The review included scholarly publications published from 2017 to 2022, and 32 articles were examined in full-text form from the screened records. 14 issues were identified and categorized in this assessment based on the technology-organization-environment (TOE) paradigm. Additionally, our analysis revealed that, in comparison to technology obstacles, organizational and environmental barriers got less attention in the literature.

Panagiotis Panagiotidis [11], stated in the paper "Blockchain in Education - The Case of Language Learning", Although Bitcoin was the subject of the first blockchain application, its benefits extend beyond cryptocurrencies and the world of business. Blockchain technology, especially in its most recent version 3.0, offers a wide range of applications in industries like data storage, product and service certification, government, insurance, health, science, and education. In order to address specific educational issues, this article focuses on the existing and future educational applications of blockchain technology.

Alexander Grech et al. [12], given in the paper, "Blockchain in Education" that explains the core concepts of the Blockchain while highlighting its potential in the field of education. It describes how this technology may upend institutional norms while also empowering students. Based on the development and deployment of technology at this time, it offers eight options for the use of the Blockchain in the context of education.

Rushabh Balpande et al. [13], stated in paper, "Usability of Blockchain Technology in Higher Education: A systematic review identifying the current issues in the education system" that the study's main goal is to discuss current difficulties that concern educational institutions and to pinpoint the proper blockchain properties that can resolve these concerns. We used a methodical literature review methodology to identify and extract valuable knowledge from the research studies that were chosen. The current issues are depicted in our research study in three different ways: financially, digitally, and physically. The study's findings indicate that the risk of manipulation, the difficulty of authenticating, and the challenge of exchanging information between institutions are the three key issues facing educational institutions. With a focus on a few issues pertinent to this field, this study explores blockchain characteristics such fragmentation, traceability, and consensus mechanism.

Jae Park [14], mentioned in the paper, "Promises and challenges of Blockchain in education" This theoretical essay investigates the effects of blockchain technology on schooling. Some claim that we are unable to take for granted that network neutrality, Internet accessibility that has gained popularity, and its impact on education would continue to exist as they do now. A better level of control over funding and investing in education, the implementation of educational initiatives, a certification/accreditation system, and learning are among the benefits promised by blockchain. With its distributed ledgers, the education blockchain would establish innovative standards for crypto-

learning and crypto-administration that are recognized by all organizations and countries, improving the objectivity, validity, and control of information without being harmed by socio-economic instability.

III. MOTIVATION

One industry at a time, blockchain technology is gradually altering the globe. Despite being the most well-known use of blockchain technology [10], cryptocurrencies are by no means the only one. Beyond its initial financial and cryptocurrency focus, blockchain technology has been breaking down barriers and bringing solutions across industries, including now in education.

IV. PROBLEM DOMAIN

Blockchain is attracting an evolving amount of interest from universities [11], businesses throughout Europe. Blockchain is a disruptive, cross-industry, worldwide technology that is still relatively young in the field of computer science.

V. PROBLEM DEFINITION

This exploratory research looks at the potential advantages that decentralised ledgers built on blockchain technology, in particular, may provide to those working in the educational sector [14]. The prospect of digital certification of both individual and academic learning is the main subject of this article.

VI. STATEMENT

The Financial sector is making extensive use of the blockchain architecture. Today, however, this technology aids in the creation of software development solutions for smart contracts, digital notaries, and cryptocurrency. Anyone can contribute inside the network on a public blockchain. Public blockchain is benefited in this sense since they offer completely decentralized, democratic, and authority-free activities.

VII. INNOVATIVE CONTENT

Greater efficiency and control over school administration and management are undoubtedly promised by blockchain and its distributed ledgers. However, the majority of its real-world applications are limited to degree certification attesting, identity authentication, and a few instances of cryptocurrency monetary transactions such as school fees and charitable contributions. The technological and philosophical limitations have been identified as the two key factors preventing blockchain technology from being widely adopted in education.

VIII. PROBLEM FORMULATION OR REPRESENTATION OR DESIGN

A blockchain is a collection of blocks that are connected by a network and hold certain information (database) in a safe and authentic manner (peer-to-peer). In other words, blockchain is a collection of interconnected computers rather than a single, centralised server, making the entire network decentralised.

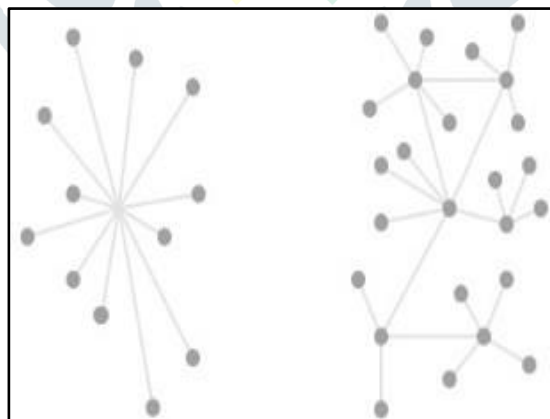


fig: centralized and decentralized blockchain architecture

Each member of the network maintains, authorizes, and updates new entries in the distributed network of the blockchain architecture. The entire blockchain network as a whole control the system in addition to specific individuals. Data validity and security are produced as a result of each member making sure that all records and processes are in order. As a result, parties who may not always trust one another are able to agree.

IX. SOLUTION METHODOLOGIES

More Accurate record Keeping using Blockchain Technology

The registrar of a school only needs to create a student's record once, as a file recorded in the blockchain cannot be altered by a single individual [13]. After that, everyone participating in the educational system has access to it, and it may even be shared between institutions.

To the student's digital record, which can be viewed in their profile, are added blocks for each task, project, involvement in the classroom, and participation in extracurricular activities. Teachers, career counselors, and administrators can get a more complete picture of their students' development.

Using smart contracts to improve student accountability

Teachers may be able to hold pupils more accountable for doing their assignments by using blockchain smart contracts. The smart contract specifies every assignment need, including the rules, circumstances, due date, and deadlines. The smart contract keeps track of the student's assignment completion and may quickly grant access to the next lesson, award the student credit, or issue a certificate of completion.

Ultimately, smart contracts can help provide highly individualized learning within the framework of a traditional classroom and supply the motivating element that is occasionally lacking in traditional educational systems.

Ways to encourage and improve lifelong learning

Numerous applications of blockchain in education can increase the fun and engagement of both teaching and learning. According to Devine, many of the popular online learning tools fall short of engaging teachers and students in this circumstance, which causes "frustration with many of the standard online learning technologies".

In this context, numerous start-ups are primarily focused on enhancing non-traditional learning by using blockchain instances. By way of illustration, BitDegree is a gamified online education platform that offers users learning incentives, such as tokenized scholarships, for finishing tech courses or hitting learning milestones on Bit Degree.

X. RESULT AND SENSITIVITY ANALYSIS

All projects that have been developed using blockchain technology have as their primary objective the examination of all issues and barriers that stand in the way of education [11] and the promotion of a true sense of education. This can offer a logical solution and be a solution to all current issues. Too many conventional documents, a lack of privacy, inappropriate data storage methods, an ineffective certification procedure, the storage of outdated records that cannot be altered, and other issues are the main issues that occur in the area of education.

XI. DATA MODEL

Private blockchains and permissioned blockchains are comparable. In the recent five years, there is a substantial growth in the amount of study on blockchain's potential applications in education, as many research projects have suggested systems that aim to address a variety of educational needs. Grech & Camilleri studied the opportunities that blockchain technology offers to education in a paper that was published in 2017 on behalf of the JRC center, which is a research and knowledge sharing service of the Europe Commission.

They came to the conclusion that blockchain-based systems could be used for permanent certificate protection, automatic credit recognition and transaction, lifelong training passport maintenance, multi-stage accreditation verification, tracking intellectual property, student identification or payment collection, and student financing.

XII. JUSTIFICATION OF THE RESULTS

As a result, the use of blockchain in education will make it easier to conduct verification and validation [5], which at first requires a very time-consuming and laborious procedure, and will instead be quick to save significant time and money. An important contributing factor to illiteracy in developing nations is poverty. The model's most noteworthy accomplishments are that they give students knowledge and skills and opportunity to advance or strengthen their economic standing.

EDUCATION INCENTIVIZATION

One of the most major use cases for blockchain is cryptocurrency and tokenization. In the near future, professors will be able to encourage students by offering them cryptocurrency rewards if they perform well or complete a particular major.

Academic institutions will be authorized to provide incentives for students to make on-time student loan payments. Additionally, the teaching-learning process may be permanently altered by the gamification element of the tokenization teaching style.

XIII. METHODOLOGY

Qualitative research methods, such as desk research, literature reviews, interviews, and case studies, were employed to collect the data for this study. Using qualitative research methodologies now [2], when the field is still in its infancy and there aren't many case studies concerning the blockchain, is a practical way to engage with the topic. Using a developing technology like blockchain, with nearly daily business announcements and posts on specialized media.

XIV. FUTURE WORK

Students may fully own their personal records thanks to blockchain technology, giving them authority over their academic identities. Overall, over the past few years, the world has changed its perception of blockchain from being the primary technology underlying cryptocurrencies to one that has enormous promise when used in brand-new sectors like healthcare and education.

It is difficult to foresee how blockchain will impact education and whether it will do so significantly and long-term. If major multinationals and/or governments don't start using and valuing digital credentials soon, several of the blockchain-in-education beneficiaries interviewed for this article claim that academic digital credentials may go extinct in five years.

A Creative Approach To Streamline Education

The blending of virtual and augmented reality with the actual world has accelerated, causing disruptions in a variety of global economic sectors. Blockchain technology, for example, offers greater efficiency and storage capacity. Cryptocurrencies are already transforming the banking sector thanks to blockchain and metaverse innovations.

Thus, incorporating these into an academic curriculum will not only give our nation's youth more opportunities, but it will also create a framework that is efficient, affordable, and easily accessible to all strata of society, allowing for greater global outreach and enhancing the learning experience for all students.

XV. CONCLUSION

Two important research questions are addressed by this study. How might blockchain technology enhance educational institutions' effectiveness and students' learning, first? What second-order barriers exist for implementing blockchain in the education sector? In this context, the paper discusses important advantages of implementing blockchain in education, adding greater confidence and transparency to social interactions generally, empowering students, enhancing security and productivity for companies, educational institutions, and students.

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