Research Article

Education Evaluation Management Based on Blockchain Technology

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In view of the problems related to the current education evaluation process, such as single evaluation index, unremarkable subject evaluation, inadequate implementation of education management measures, and low recognition of the results of education evaluation, particularly in China, more research is needed to ensure appropriate educational management. Security of the evaluation metrics and communication among institutes is very essential to ensure the education quality. In this paper, we adopt the blockchain technology to evaluate the current education. All-round evaluation of quality makes the whole process of education evaluation transparent and open and solves the defects existing in the process of education evaluation. The blockchain technology establishes a management mechanism for educational evaluation by cooperating with educational institutions and promotes the implementation of quality measures, as well as the implementation of policies. Furthermore, this provides a blockchain information data platform for educational evaluation and prevents the information from being tampered with, either in decentralized or centralized systems, thereby promoting the development of education.

1. Introduction

At present, there are still many deficiencies in education evaluation management. The use of blockchain technology can decentralize the education evaluation process, classify and store evaluation data, strengthen the confidentiality of data, and prevent data from being tampered with. The consensus contract reached in this paper makes the data more authentic and reliable and has a wide range of applications in educational evaluation management, providing a reliable source of information for the process of educational evaluation management and improving the quality of educational evaluation. This technology establishes a management mechanism for educational evaluation by cooperating with educational institutions, promotes the implementation and implementation of policies, provides a blockchain information data platform for educational evaluation, and prevents the information from being tampered with and centralized, thereby promoting the development of education.

To evaluate the performance and constraints of these cutting-edge platforms, Pongnumkul et al. [1] performed a performance analysis of two well-known private blockchain platforms, namely I Hyperledger Fabric and (ii) Ethereum (private deployment). It is unfortunate that there are few uses for blockchain technology in the education industry given that it can solve a number of problems, including the lack of user interaction and system interoperability in e-learning systems. By using the blockchain technology to address the aforementioned problems, Zhong et al. [2] present a conceptual model for e-learning systems and utilise the word-learning community as an example. To obtain the practical advantages of the supply chain process design, Chang et al. [3] proposed a blockchain-based architecture coupled with the use of an associated technology, namely, smart contracts. Fast query processing is supported
by the spatio-temporal blockchain technology that Qu et al. [4] developed. Despite these works, this blockchain-based education research still has limitations and implications. The study presented in [5] was created utilizing data from three SMEs in India’s growing economy, which was then used to assess 15 selected hurdles. The goal of the study finished in [6] is to build a model of a business process based on blockchain technology that can enhance data integrity in academic institutions.

The Internet of Things (IoT), machine learning, and the blockchain technology for supply chain networks were all included in Li et al.’s [7] proposal for a production capability evaluation system. In Meng et al. [8], the author’s goal is to look into how well blockchain-based trust management systems perform, which is inspired by the growing popularity of the technology. A trustworthy search system without verification was put up by Li et al. [9] and is based on a consortium blockchain for data storage and sharing. Other works such as [10–13] and [14] have also implemented the blockchain technology in various real-world scenarios. However, we believe, to the best of our knowledge, that the blockchain technology is not maturely used in the education evaluation systems.

In view of the problems of single evaluation index, unremarkable subject evaluation, inadequate implementation of various education management measures, and low recognition of the results of educational evaluation in the current education evaluation process, this paper adopts the blockchain technology to evaluate the current education management system. We design an architecture for the education evaluation system which is based on the blockchain concepts. We then construct a blockchain-based teaching evaluation diagram that is a part of the proposed system. Finally, an education evaluation scheme is presented and evaluated through experiments. The attained results show that the proposed system can reduce the burden of information on the storage system significantly when compared to other traditional evaluation systems.

The remaining part of the manuscript is outlined as follows. The design of the educational evaluation management system is deliberated in Section 2. The application of the evaluation system is discussed in Section 3. Results and discussion are discussed in Section 4. Finally, Section 5 summarizes this paper with several guidelines for future research.

2. Design of Educational Evaluation Management System

2.1. The Overall Design Structure of the System. The infrastructure layer, network layer, consensus layer, data layer, smart contract layer, interface layer, and application layer make up the architecture of the blockchain-based school evaluation system. In the system architecture composed of all layers, each layer undertakes different services role. First of all, the infrastructure layer, as the top layer of the system architecture, mainly provides basic information services for the quality evaluation of the education, collects the relevant information for education evaluation, and organizes and transmits the information to the next layer. The network layer, as the communication transmission layer, provides a platform for information exchange among the nodes in the form of an information hub in the network nodes of the blockchain. The data results of the educational evaluation are packaged and sent out in the form of blocks. The corresponding network nodes will receive the results of the educational evaluation [15]. The so-called consensus layer is to keep the data of all nodes of the blockchain updated and consistent and to reach a consensus, so as to ensure that the data of all nodes of the blockchain are open and transparent, and to achieve data sharing [16].

The data layer stores the timestamp, random number, and encrypted information of the blockchain and stores the information to maintain the integrity of the data. The smart contract layer is to classify the data of the blockchain and divide it into small area modules to prevent the data from being tampered with or deleted [17]. The interface layer provides a channel for data query and access for education departments and universities and can enter the system for consultation and viewing directly through the relevant communication protocol [18]. The application layer can enter or collect educational evaluation information, evaluate related educational and teaching activities, and find the effect of educational evaluation. The system architecture of education evaluation management in this paper is shown in Figure 1.

2.2. Information Chain of Education Evaluation. The composition of the educational evaluation information chain based on blockchain technology is mainly composed of the evaluation subject block, evaluation data block, evaluation method block, weight distribution block, and block database, and the connection between each block is not divided while realizing information transmission and sharing, and each block maintains independent work and close contact [19].

First of all, the objects of the evaluation subject block include education departments, school leaders, teachers, students, parents, educational institutions, and social media. The objects in this block are registered in the blockchain, thereby obtaining authorization in the education evaluation system. The main block can be evaluated and referenced by multiple parties, and the evaluation results obtained have a certain breadth and authenticity, which can reflect the quality and effect of education to a certain extent [20].

The evaluation data block mainly stores all data information, including historical data records, currently collected information records and future data information. The data block system classifies and stores various types of information, and historical data can be recorded. The data of educational evaluation are entered as an important source of reference information [21–23]. In addition, the current data information is mainly that the school enters the current educational evaluation situation into the system so that on the basis of historical data and current data, the school can automatically generate future data based on the two and record the teaching evaluation in real time [24].
The evaluation method block can use the fuzzy hierarchy process and the analytic hierarchy process to analyze the educational evaluation, and quantitatively process the evaluation indicators in concept, and then analyze the weight ratio of the educational evaluation indicators by the analytical hierarchy process, and construct a quantitative judgment. Based on the evaluation matrix, the numerical value of the evaluation index is calculated, and on the basis of the educational evaluation model, the multilevel comprehensive evaluation is used to obtain the weighted value, and finally, the result of the educational evaluation is obtained.

The weight allocation block is mainly based on the evaluation object, the evaluation subject, and the different content of the evaluation data, and the size of the weight can be set according to the actual situation. Therefore, after assigning the weights, the evaluation results of education can be obtained.

The database block is composed of evaluation records, evaluation results, and educational evaluation information of the evaluation subject [25]. The timestamp and consensus protocol on the blockchain ensures that the data in the block is not tampered with and maintains the authenticity of the data.

3. The Application of the Evaluation System

The blockchain is the core content of the educational evaluation system. The educational evaluation management system established in this paper along with the blockchain methodology is shown in Figure 2. As shown in Figure 2, the students, teachers, employees of the educational institutes, and testers are basic modules of the proposed blockchain-based education system. In fact, teachers are making the quality of education, whereas the testers are used to evaluate the quality with respect to various metrics including the student’s opinion, as well as, the suggestions received from other employers of the education institutes that constitute the blockchain system.

3.1. The Operation of the Educational Evaluation System

From a macro perspective, the decentralized joint mechanism uses the blockchain architecture model to connect various main objects of different functions together to form the main chain, and each main object on the main chain has a protection. The authority of their own privacy, for data sharing, the exchange, and sharing of data is realized on the basis of the consensus mechanism. The different main chains in the evaluation system are connected to each other through network nodes, and each accounting point can be authenticated by the user to form a cogovernance alliance in the field of educational evaluation. In addition, each user obtains the education quality evaluation information on the blockchain through smart contracts to ensure that the data information on each main chain is not tampered with. Various organizations connected to the blockchain complete various transaction requests of users in the rating process through a consensus mechanism. The educational evaluation scheme is

![Diagram](image-url)
shown in Figure 3. In the application, tasks such as data analysis and query processing within the database are carried out. In the network acceleration, data movement and secure transmission are ensured between the education institutes. Strong security is the fundamental feature of the blockchain technology, and in this stage, it is guaranteed that the data and information do not tamper with during operation. The value of service (VoS) assures the key services of the blockchain technology such as smart contract and consensus roles.

3.2. System Evaluation Process. The management of educational evaluation must first ensure the authenticity of the data, ensure that the data entered into the system can reflect the real situation, and the collected data must be entered into the system in real time. For example, according to the requirements of educational evaluation, it is necessary to enter the educational evaluation team building, educational evaluation organization construction, and educational evaluation time limit into the system. In addition, the system can collect relevant educational and teaching activity data according to the big data network and use analysis tools to process and analyze the data, so as to ensure that the data can be updated in time.

In addition, improving the credibility of education evaluation management is also an indispensable content; especially, when using big data analysis software to analyze education and teaching, the evaluation report generated should present rich data content, so that the evaluation results are clear. Therefore, the education evaluation of the blockchain needs to open a certain evaluation authority, so that different subjects can evaluate education according to the contract mechanism, and the system will store the results of each subject’s evaluation on the node.

Finally, the results of the system assessment should be queried and applied. After the main object of the blockchain logs into the system for verification, it can query the evaluation results of the corresponding main chain and nodes and understand the detailed evaluation process under the guidance of the rule contract. Then, the main object can use the results of education evaluation as the evaluation standard for judging the quality of school education and teaching according to the relevant evaluation indicators, reach a consensus with other smart contracts, and enter the main chain node of the system together to continuously expand the value of education evaluation management.

4. Results

The cloud resource information of the educational evaluation system and the process of operational data in the blockchain environment increase linearly from 1024 B to 1 GB with 10 MB as a unit. According to the above parameter setting results, the storage structure analysis and data information flow model construction of university educational system process operation data under the blockchain environment were carried out, and the cloud resource storage data information flow collection is realized. It can be seen from Figure 4 that using this method for Atlas design and feature extraction can accurately reflect the internal structure information features of the university educational system process operation data under the blockchain environment and improve the cloud storage performance.

To compare the results of the proposed blockchain-based system (denoted by OUR) with other methods, we selected two state-of-the-art techniques, that is, EMD (empirical mode decomposition) and WA (wavelet analysis). Both algorithms were implemented without the blockchain technology. In order to quantitatively analyze the improved performance of this method, the cloud resource storage overhead is taken as the test object, and the comparison results are shown in Figure 4. It can be seen from the figure that using this method can effectively reduce the storage overhead and improve the data throughput. The through of data can be significantly increased as shown in Figure 5. The consensus contract reached in this paper makes the data more authentic and reliable and has a wide range of applications in educational evaluation management, providing a reliable source of information for the process of
5. Conclusions and Future Work

At present, there are still many deficiencies in education evaluation management. The use of blockchain technology can decentralize the education evaluation process, classify and store evaluation data, strengthen the confidentiality of data, and prevent data from being tampered with other information. The consensus contract reached in this paper makes the data more authentic and reliable and has a wide range of applications in educational evaluation management, providing a reliable source of information for the process of educational evaluation management and improving the quality of educational evaluation. We observed that using the suggested method can effectively reduce the storage overhead and improve the data throughput. In the future, we will adopt other metrics to deeply investigate various measures for the quality evaluation of present educational institutes. We will also investigate how the proposed system can be implemented in a real-life scenario.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References


