

# Research on the Construction of Student Learning Effect Traceability System from the Perspective of Blockchain

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## Abstract:

With the social attention to the teaching quality of undergraduate education, how to effectively apply academic evaluation has become an urgent problem to be solved in teaching practice. The educational concept of “student-centered” requires paying attention to the learning process and learning effect of undergraduates. Process evaluation has become a recognized evaluation method in theory and practice. However, at present, the construction of students’ learning traceability system is not perfect, and there are still some problems, such as information asymmetry, lack of traceability links, training black box and so on. In view of these problems, this paper takes the learning effect of undergraduate college students as the research object, and constructs a student learning effect tracking system from the perspective of blockchain through specific cases. The purpose is to evaluate the growth of students and the talent-cultivating effect of higher education institutions, and provide visual data support for the improvement of teaching effect and students’ learning process, hence promoting the reform of teaching evaluation mechanism and the improvement of talent training level.

**Keywords:** Blockchain, Traceability system, Student learning effect.

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## I. INTRODUCTION

In today’s world, with the rapid development of economic globalization, the competition among countries is actually the competition of scientific and technological strength with intellectual property rights as the core, and behind the scientific and technological competition, the core is the competition of talent quality and quantity. The quality of higher education has become the focus of attention all over the world, from the initial expansion of higher education scale to the improvement of quality [1]. How to evaluate the quality of higher education and quantify the whole training process of students has become a hot issue for researchers, mainly focusing on the following aspects.

For the talent-cultivating in higher education institutions, the achievement degree of talent-cultivating objectives has not formed a dynamic scientific management and an effective mechanism of supervision and evaluation; The lack of dynamic talent training evaluation feedback directly affects the actual effect of ability evaluation in talent training. Of course, it is more difficult to measure whether the training objectives in the professional talent-cultivating program of colleges and universities have been achieved. At the same time, the new talent-cultivating program needs an intuitive and comprehensive analysis of the previous training results. However, the current talent-cultivating management mechanism is difficult to support the iterative renewal of the new talent-cultivating program.

For the evaluation of students' learning effect, the current graduation achievement of college students is only a transcript summarized from the achievements of various courses and a graduation thesis. The evaluation of the whole learning process of college students in the four years of university is often missing [2]. It is difficult to tell what students have experienced in the four-year professional training in universities, which is called the black box of the learning process. How to open the black box, let schools and students know their learning data, and adjust in time, hence becoming better themselves.

For enterprises, the information of graduates that can be obtained is often a resume and transcript, and the candidates fail to effectively convey their personal panorama to the enterprise due to their lack of application experience. This leads to problems such as asymmetric information and insufficient information transmission in human resources recruitment, which not only affects the judgment of enterprises on job seekers, but also damages the interests of enterprises in human resources recruitment [3].

## **II. CONNOTATION OF QUALITY TRACEABILITY SYSTEM**

### **2.1 Quality Traceability**

There is no unified statement in the academic circles of quality traceability theory. ISO (International Organization for Standardization) defines quality traceability as the ability to trace the past, application and existing position of an entity by using marks. Quality traceability was first used in the production, manufacturing and circulation of industrial products. Because it can accurately monitor products to improve product quality, it has gradually been widely used in the field of agricultural product quality. No matter which field, its core is to use the recordability of information transmission to supervise the whole process of each link of production, opening the black box between enterprises and consumers.

## 2.2 Quality Traceability System

Quality traceability system refers to the quality assurance and query system that records and stores the relevant quality information of each link of the product through unique identification in the whole process of production and supply. The system can carry out quality certification in advance, keep tracking the quality, make the production process transparent, and then enhance the subject's sense of responsibility and effectively improve the quality of products.

## 2.3 Traceability of Learning Effect

Higher education institutions could introduce quality traceability into the field of learning effect evaluation, purposefully and consciously collect and display learning achievements and other materials, including students' articles, audio recordings, video recordings, drawings, photos, finished products, etc., as well as the summary of learning experience reports written by students themselves reflecting their learning experience, with appropriate written descriptions. It can be composed of students' basic information, process information and result information. Basic information refers to students' social attributes, such as age and gender, and psychological information, such as learning interest, demand, and preference. Learning process information is the information generated and recorded by students in the learning process, including learning objectives, learning plans, learning activities and so on. Learning result information refers to the result data generated after learning, including learning works, learning achievements, learning reflection, etc. This process can realize the whole process and full participation quality management of students' learning based on the talent training scheme from enrollment to graduation.

# **III. BLOCKCHAIN TECHNOLOGY HELPS TO REALIZE THE TRACEABILITY OF STUDENTS' LEARNING QUALITY**

In the construction of student learning quality traceability system, how to ensure the authenticity of information and the symmetry of information among stakeholders, so as to improve the traceability of learning quality? This has become a hot issue for scholars.

## 3.1 Blockchain Technology

As one of the cutting-edge information technologies, blockchain technology has the characteristics of tamper proof, distributed, decentralized and traceable, and has been highly valued by national governments, enterprises and scholars in various fields. Many scholars combine blockchain technology

with the Internet of Things technology, Radio Frequency Identification (RFID), wireless sensor network and visualization technology to make it more transparent, so they choose blockchain technology [4].

### 3.2 Advantages of “Blockchain Education” Mode

#### 3.2.1 Academic information

In essence, blockchain is a new data storage method. Academic learning data, students’ growth files and other data related to learning history can be stored and recorded. ‘Blockchain Education’ can make use of the anonymity and privacy of the blockchain to open up the current data island and allow students, schools, enterprises and evaluation departments to share data, so as to optimize the data supply end and “teach students according to their aptitude” [5].

Putting important information such as students’ personal files, grades and academic qualifications on the blockchain could prevent information loss and malicious tampering. In this way, the recruitment department of enterprises can truly and reliably obtain students’ personal files and effectively avoid some problems such as academic fraud. The blockchain can directly establish the connection between users and educational resources, and users can directly access some learning videos on the chain to realize the point-to-point connection between consumers and resources without using a centralized platform, reducing users’ expenses.

For higher education institutions, it is a difficult task to keep students’ performance records, because these records should be kept for a lifetime. In 2019, the scale of China's education informatization market was about 430 billion RMB, of which the financial education fund contributed about 70-80% [6]. The use of blockchain technology can reduce some financial expenditure. Records, documents and digital assets can be supported and stored without any additional infrastructure and security costs, because of the inherent flexibility in the blockchain architecture.

#### 3.2.2 Digital certificate

The use of digital blockchain certificates or diplomas can also eliminate the need for traditional stock exchanges or universities as intermediaries for issuing transcripts. If students start to store all their certificates and badges on the blockchain, the migration of those information between different universities will be much easier, and the transfer of credits will no longer be an obstacle to their educational journey. Blockchain is very secure, once the data is added, it is almost impossible to change. Therefore, all certificates are secure and can be accessed by clicking a button.

### 3.2.3 Education evaluation

“The real revolution in the future education field in China is not the AI revolution, but the subversive revolution caused by the combination of Internet, AI and blockchain technology. The characteristics of blockchain technology are that the data cannot be tampered with, and the learning track of students in college can be recorded. Then, through AI analysis reporting, how many learning activities students have participated in and how many certificates they have obtained, in the past four years, can be irrevocably recorded in the system and become important credentials for future enterprise applications [7].”

## **IV. BUILD A STUDENT LEARNING EFFECT TRACEABILITY SYSTEM UNDER THE BACKGROUND OF BLOCKCHAIN TECHNOLOGY**

### 4.1 Construction Ideas of Student Learning Effect Traceability System

Learning effect tracing is mainly aimed at students' learning process, tracking students' course scores, reading information, participation activities, training, internship practice and students' scientific research activities in real time, establishing information tracing and information sharing mechanism, and realizing the overall development of tracing and source tracing function in the whole learning process.

In the educational chain of students' learning and growth, due to the diversity and richness of learning activities, the subject presents a networked development, which requires a stable and safe traceability system to upload, store, query and visualize the information in the process of students' learning, and ensure the security and authenticity.

The student learning effect traceability system based on blockchain can meet the application needs of schools, students, enterprises, and government evaluation departments. 1) From the perspective of universities, they could better grasp the learning regular pattern of students and timely adjust the talent-cultivating mode based on the talent-cultivating objectives. At the same time, it can also provide important reference basis for enterprise recruitment and students' enrollment to a higher academic degree. 2) From the perspective of students, they can clearly understand the whole process information of each stage of learning, timely find out and fill vacancies, promote students to understand themselves, develop actively and improve themselves comprehensively. 3) From the perspective of enterprises, through the data acquisition of students in the whole training process, it is helpful for enterprises to have a more comprehensive understanding of students' professional ability. 4) From the perspective of the government evaluation department, the blockchain can realize the whole process supervision and accurately evaluate the talent-cultivating of the colleges and universities.

## 4.2 Comprehensive Framework Design

The blockchain based student learning effect traceability system framework includes application layer, platform layer and foundation layer. The comprehensive framework is shown in Fig 1.

The process from enrollment to graduation involves multiple subjects, and each node contains a large amount of data.

The information collection layer mainly collects information by using various effective information collection terminals for each link of students' learning activities and uploads it to the data management layer, which is also the main data source of the traceability system. Among them, the education base module collects the data generated by students in teaching, such as course assignments, grades, project reports, and even published papers. In the teaching and research workshop module, students' participation in school curriculum reform, training and other data are collected. The learning center module mainly records the data of students' reading bibliography, certificate acquisition and participation in competitions during school, as well as the study tour module to record the process of students' broadening their horizons.

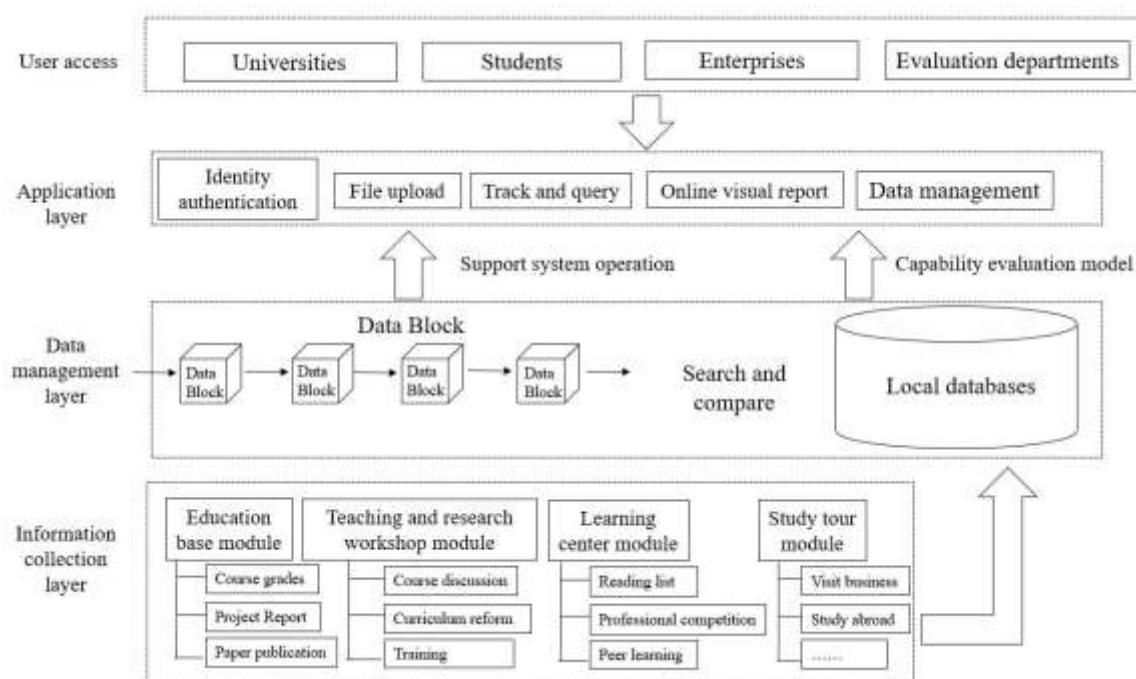


Fig 1: framework of student learning effect traceability system based on blockchain

The data management layer mainly stores and verifies the data collected by each node in the information collection layer, and reaches a consensus on the uplink through the whole network broadcast consensus, which helps the system application layer conveniently extract and use the data.

On the one hand, the system application layer can show the comprehensive application of information collection layer and data management layer, and can also provide data interfaces for colleges and universities, students, enterprises and evaluation departments to share data and jointly supervise.

## **V. CASE STUDY OF TRACEABILITY SYSTEM**

The major of Finance, Economic Statistics, and Data Science and Big Data Technology of Xi'an Eurasian University uses the school's powerful teaching information system to build a blockchain platform, which cannot only ensure the liberation of more data, but also ensure the security of data. The platform collects the construction index system related to students, records the detailed data of students' learning and participation in various activities during the implementation of talent-cultivating program, and creates students' electronic files. Constructing the student growth process index system based on the professional talent-cultivating objectives, combined with the human resources related ability evaluation model, analyzes the relationship between the actual achievement of the ability set in the professional talent-cultivating scheme and the expected goal, realizing the process tracking and dynamic optimization of the talent-cultivating scheme, and also giving the effect evaluation of professional training.

### **5.1 Research Object**

The research object is 312 students in 9 classes and 3 majors of Finance, Economic Statistics, and Data Science and Big Data Technology of Xi'an Eurasian University. Students' electronic portfolio includes six categories of indicators to reflect students' abilities in all aspects: course performance, reading information, participation activities, training, internship practice and scientific research activities.

### **5.2 Application of Traceability System**

The learning effect traceability system is built on the regular data collection, management and display application of students' learning process. Firstly, combined with the professional talent-cultivating program and the discussion with the professional classroom, determine the process data to be collected, and collect the students' learning process data through multiple departments and teachers and students. Data collection is carried out through the Tronclass platform, including data generated by

students' behaviors related to the course, graduation practice, thesis process data, the Second Class, and other data.

Secondly, through analysis and calculation, the data is uniformly stored in the background and displayed, showing the students' learning results and professional training results, and feeding back the results to students, major course center, and enterprises for timely optimization. By combining and integrating the indicators from their four years of curricular and extracurricular activities in the University, students' ability is calculated from two aspects: academic achievement and non-academic activity.

The learning effect tracing system records the detailed data of students' learning and participation in various activities during the implementation of the talent-cultivating program. Through analysis and visual display, it mainly feeds back four aspects of problems. (1) For the professional course center or group, it is conducive to have an intuitive understanding of the gap between the ability objectives set in the talent-cultivating program and the actual achievement, so as to further realize the tracking and dynamic optimization in the implementation of the program; (2) For individual students, visual e-learning archives can initially achieve the dynamic portrait of students, based on comparing the expected training objectives, hence enabling students to timely understand their current position in career development, clarifying their personal advantages and disadvantages, and providing students with accurate academic planning and assistance; (3) For enterprise, issuing a third-party detailed electronic resume for each student to solve the problem of information asymmetry between enterprise HR and graduates. (4) Students' e-learning archives can also become a window for high school graduates and parents to understand the colleges and universities, so that they can more clearly understand the talent-cultivating objectives and achievements of the universities and majors they want to enroll for, and help the school form a brand effect. As shown in Fig 3.

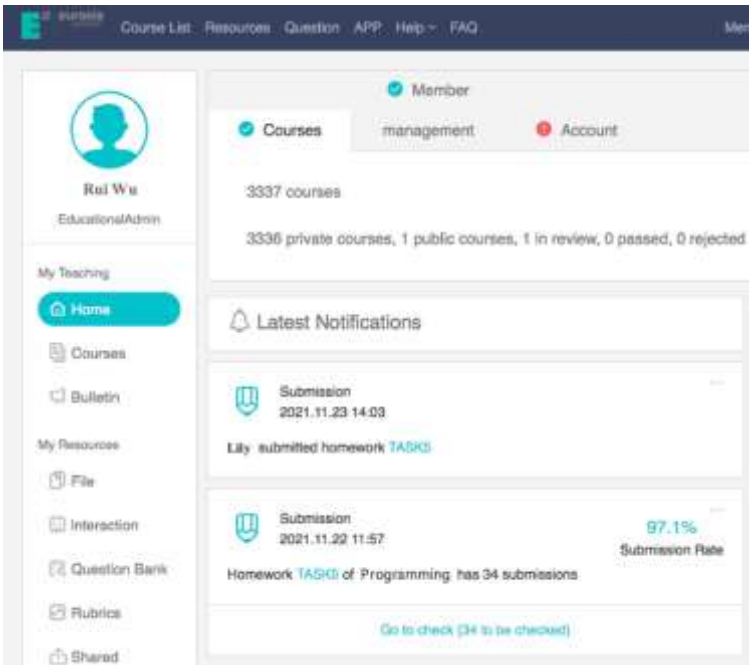


Fig 2: traceability system platform

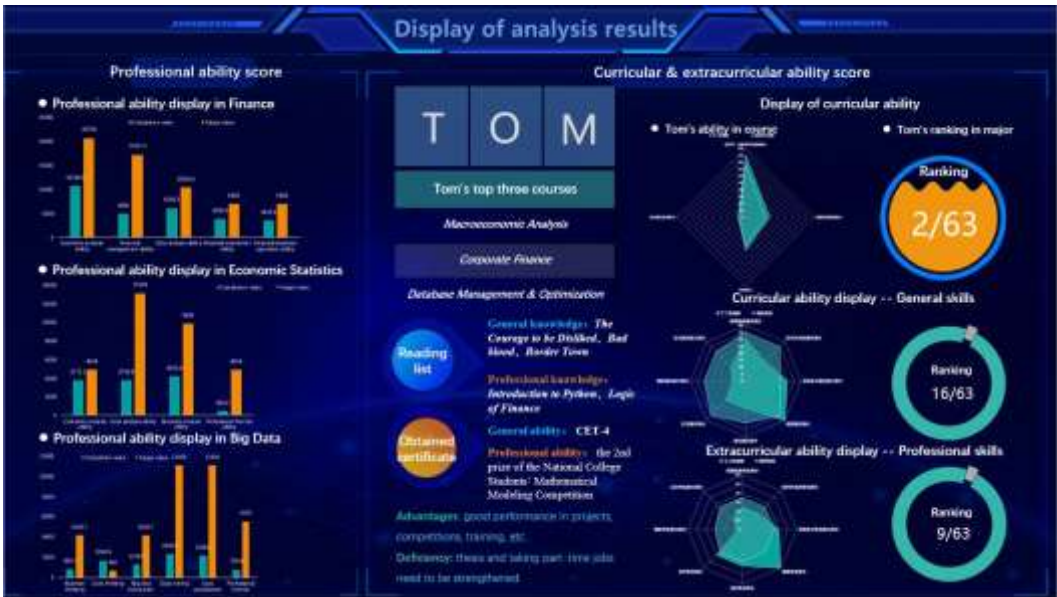


Fig 3: visualization of traceability system

Based on the actual situation and students' demands, the learning effect traceability system should clarify the learning objectives and evaluation standards, formulate detailed and effective schemes, provide clear samples and guidance for users, and improve the efficiency of electronic portfolio, so as to realize the function of truly showing students' learning process and results.

## **VI. EVALUATION AND CHALLENGES**

Niguidula (1993) pointed out that students' abilities cannot be truly understood by relying only on grades [8]. Thus, the traceability system combined with blockchain technology can help teachers, schools and even education departments understand students' abilities more comprehensively based on overcoming the shortcomings of paper archives that are difficult to store and occupy space. At the same time, it also plays a role in promoting learners' critical thinking and their lifelong learning ability.

There are also many challenges in the construction and analysis of learning effect traceability system. The first is the source of data and the scientificity of index extraction. Collecting the resulting documents generated by students' learning behavior not only needs the strong information system as the support of colleges and universities, but also due to the lack of systematic guidance and training, some students said they encountered difficulties in uploading works, so that the integrity and standardization of data bring new challenges to the scientificity of subsequent data index extraction. Secondly, the scoring criteria for the qualitative data of students' extracurricular activities can be more refined, which can basically consider various situations, and more clearly point out which ability could support a certain activity. Finally, after determining the standard data format, the university should build an online database, and collect students' data regularly, and then timely input the data into the established database, so as to prevent inaccurate data calculation due to students forgetting their participation in activities.

## **VII. SUMMARY**

From the perspective of blockchain, this paper applies traceability to the construction and operation of students' learning effect traceability system, which not only ensures the authenticity and reliability of students' cultivating quality traceability information, but also makes the whole process of students' cultivating visible, so as to improve the public reliability and application effect of students' cultivating and evaluation, and lay a foundation for the evaluation of talent-cultivating quality in higher educational institutions and the employment of enterprises.

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