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Reshaping the EFL Formative Assessment Pedagogy With Blockchain Technology

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Abstract

Blockchain technology is a distributed database with features such as no forgery, full traceability, openness, and transparency which is superior in establishing trust mechanisms and brings new opportunities for finance, healthcare, technology, and education. As a required course of all universities in China, College English has a large demographic covering millions of students. But the traditional EFL summative assessment model fails to fully reflect the L2 learner's learning process and increment performance. The current paper focuses on the novel applications of blockchain in the educational domain and how blockchain technology reshapes the EFL Formative Assessment framework in the consensus mechanism to achieve a decentralized and highly trusted learning process record and evaluation. This innovative approach aims at improving the openness, transparency, and fairness of the EFL learning process by recording and monitoring the teachers' and students' behaviors. The research findings of this paper provide preliminary exploration for L2 evaluation and supply some inspiration to policymakers, EFL practitioners, and technology developers about the potential usages of digital credentials anchored on blockchains.

Keywords: blockchain, formative assessment, traceability, tamper-resistant, credit bank

1. Introduction

1.1 Research Background

Smart EFL education is a kind of education using 5G, artificial intelligence, big data, cloud computing, blockchain, and other new technologies to form a smart learning environment, through the deep integration of information technology and L2 education (Gong, 2021). Blockchain research is currently experiencing an explosion of growth. A blockchain is like a giant ledger. It is equivalent to a page of the ledger, allowing each node to participate in maintaining it. When a page is completed, it will be encrypted and packed into the chain, and stamped with a timestamp, so every node information can be traced and cannot be tampered with. The core feature of this technology is decentralization, which means that peer-to-peer transactions and collaboration are realized in a distributed system through the use of data encryption, timestamps, distributed consensus, and economic incentives. Thus, effectively solving the problems of high cost, low efficiency, and insecure data storage prevalent in centralized institutions (Qing, Jiang, & Wang, 2016). Due to its decentralized and traceable nature, blockchain was first applied to the financial sector and quickly penetrated other industries that also contain huge data. In China, the application of blockchain technology in the education sector is still in its nascent stage. With the issuance of a series of policy documents based on the exploration of blockchain technology, such as the White Paper on the Development of Blockchain Technology and Applications in China (Ministry of Industry and Information Technology, 2021) and the Action Plan for Blockchain Technology Innovation in Higher Education Institutions (Ministry of Education, 2020), blockchain in education has undergone a development process from theoretical research to technical research and application research, which to a certain extent releases a signal that "Blockchain + Education" may play a significant role in a wider scope.

1.2 Research Significance

With the rapid development of information technology and the continuous enrichment of network resources, there are many problems in the field of education, such as the high incidence of academic fraud, falsification of learning records, academic forgery, and confirmation of intellectual property (IP) rights. Educators have to rethink: under the transformation of education management mode brought about by the growth of digital learning

demand, how to ensure the openness and equality of digital resources? How can EFL teachers ensure the authenticity and credibility of a digital learning experience? How can EFL teachers ensure the security and reliability of digital information? How do we reshape the roles of teachers and educational organizations in future education? The development and maturity of blockchain will provide excellent solutions to those puzzles. In particular, blockchain technology effectively assists the reform of EFL education and has important implications for the current assessment methods of EFL education.

1.3 Research Objectives

Given the current situation above, this paper aims at constructing an EFL formative assessment framework based on blockchain technology, exploring the innovative application of blockchain in the L2 education domain. Hopefully, this research may guide EFL practitioners on the operational implementation of a blockchain-based infrastructure.

1.4 Research Questions

RQ 1: Why is blockchain technology adaptable to the educational field?

RQ 2: How will blockchain technology be integrated into the EFL formative assessment framework?

2. Definition of Blockchain Technology

2.1 Definition

Blockchain is a combination of cryptography, blockchain data structure, distributed storage, and other information technology innovations (Nakamoto, 2008). The values of blockchain, with the fidelity, transparency, and traceability of data security sharing technology, have realized the transformation from the traditional information Internet to the interconnection of credit and value. That is regarded as the cornerstone of the digital economy. In layman's terms, blockchain is an emerging network technology in which one or more servers on a network (LAN, Internet) store transaction data, constituting a "block", and each "block" is linked together through the network to keep all server transactions within the block consistent. Any changes to the data on the chain are recorded and stored on different servers. Modifying the data on one of the servers will lead to warnings of inconsistencies with the data on the other servers, ensuring that the data cannot be tampered with mechanically, which is very important to education administration.

2.2 Adaptability of Blockchain Technology in the Education Domain

1) Open and transparent. A blockchain is essentially a distributed database. Distributed means that every blockchain network node has equal access to transactions and equal access to transaction information. In a typical blockchain network, each node can store a complete and consistent ledger of historical transactions that have occurred across the network.

2) Traceable and tamper-resistant. Traceability and immutability go hand in hand. Traceability means that the information is permanently stored and true and complete, while immutability ensures that the information is true and complete and can be used for information traceability. Blockchain uses a one-way hash algorithm, timestamp technology, and consensus mechanism to make block transactions advance in order of timeline, and each block will be timestamped when it completes adding chains and provides time confirmation of transaction information, which strongly guarantees the tamper-proof of block data. After network-wide broadcast verification, only nodes with more than 50% of the network's computing power can tamper with it, which is almost impossible (Luo, 2016). Therefore, blockchain technology has a high degree of trustworthiness of being tamper-evident and traceable.

3) Cryptography security. Blockchain technology generates the corresponding public and private keys through hash encryption algorithms and authenticates in both directions. In asymmetric encryption technology, a public key is used as the public key, and another secret key is kept secret and becomes the private key. The public key is used to encrypt the message and the private key is used to decrypt it. In the case of knowing one key, the other key cannot be deduced, and both parties to the transaction remain anonymous, thus ensuring privacy and security (Ba, Zhang, & Zhu, 2020).

4) Decentralized or weakly centralized. Blockchain uses peer-to-peer (P2P) networks, whose peer-to-peer transmission technology is the basis for moving away from centralized server control and forming a public ledger (Deng, Wei, & Wu, 2019). In a blockchain network system, there is no central trust organization, and its free and reliable peer-to-peer transactions are achieved by consensus trust mechanisms.

Therefore, blockchain is highly compatible with education and has promising applications. Different learners are constantly inputting and outputting knowledge, during which record-worthy learning data are constantly

generated, which have the value of evaluation and authentication, and dissemination and sharing. Therefore, I firmly believe that the application of blockchain in the EFL education assessment is justified. The application of blockchain facilitates the recording and management of education data more scientifically and credibly, and protects the learners' own right to information and ownership of learning data. The specific adaptation is illustrated in Figure 1.

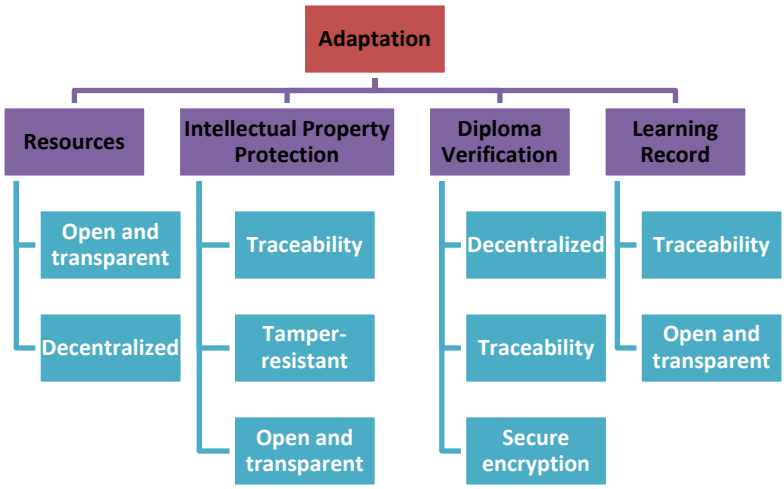

Figure 1. Adaptation of blockchain technology

3. Literature Review

In 2017, the European Union released the report "Blockchain in Education", introducing the basic principles of blockchain in education applications and proposing eight options for the use of blockchain technology in education based on the development and deployment of the technology (EU, 2017). In 2020, China's Ministry of Education released the "Action Plan for Blockchain Technology Innovation in Higher Education Institutions" (Ministry of Education, 2020), which systematically covered almost all important aspects of the new blockchain infrastructure and the integration and application of blockchain technology, indicating the direction for blockchain technology application research and school-enterprise cooperation in universities. In the same year, the American Council on Education released the report Connected Impact: Unlocking Education and Workforce Opportunities through Blockchain, which analyses existing and potential cases of blockchain in the education sector (American Council on Education, 2020).

Xue and Ma (2016) analyzed the advantages and features of using blockchain technology to build a new Student-Behavior-Evaluation-System, to record and evaluate the comprehensive performance of university students, including academic performance in school years. In terms of maintaining the authenticity and validity of educational records, Li and Zhang (2017) argued that blockchain technology can be utilized to collect key learning data of learners, record them and upload them onto the chain, thus effectively curbing various cheating and falsifying behaviors, while also providing a data and information basis for employers to select and train talents.

There are already some successful real-life cases of blockchain education startups that help to transform education. The MIT Media Lab has released BlockCerts, an app enabling students to quickly and easily get a verifiable, tamper-proof version of their diploma that they can share with employers, schools, family, and friends. To ensure the security of the diploma, the pilot utilizes the same blockchain technology that powers the digital currency Bitcoin. It also integrates with MIT's identity provider, Touchstone (Durant & Trachy, 2017). In addition, BlockCerts can be used to issue any type of credential, including professional certificates, transcripts, credits, or degrees. Over 600 MIT graduates in 2018 chose to receive a digital version of their BlockCerts blockchain diploma. Additionally, the Disciplina platform in Tallinn, Estonia, uses blockchain technology to track students' learning progress. Each student is given a score based on their performance in class, participation in extracurricular activities, and other achievements. Schools and colleges registered on the platform use these scores to personalize the learning process and create specific plans for each course, introducing convenient tools for assessment, grading, and commenting. Recruitment agencies and employers can also register on the platform

to find potential candidates.

Having reviewed this literature, however, any research exploring the practice of blockchain technology in the field of EFL formative assessment has not been found so far. Hence, it is necessary to conduct this research. Formative assessment has been advocated for a long time, and yet it is still not mature because it is uneasy to track every detail of teaching and learning. Applying blockchain can cope with this challenge. Notably, the traceability, reliability, and immutability of blockchain mean that the data recorded on blockchain are more specific, authentic, and anti-theft. These unique features of distributed ledger technology make it an appropriate technology for this purpose.

4. Evolution of EFL Formative Assessment Pedagogy

Evaluation is a problematic issue in the L2 education system for a long time. Formative assessment was first proposed in 1967 by M. Scriven, an American expert in assessment. He argued that formative assessment is a planned, ongoing process used by all students and teachers to elicit and use evidence of student learning to improve student understanding of intended disciplinary learning outcomes and support students to become self-directed learners (Scriven, 1967). It was later applied to teaching by the American educationalist B.S. Bloom. Formative assessment focuses on students' mastery of knowledge and skills during teaching and learning activities. By systematically testing and comprehensively evaluating students' learning achievement in the process of forming their knowledge, abilities, and attitudes, teachers apply the results of feedback to further improve teaching effectiveness and promote effective learning (Bloom, Hastings, & Madaus, 1971).

One of the important elements of the EFL assessment system is to assess whether students can communicate professional information in English. The formative assessment should focus on the development of diagnostic tests. A multifaceted teaching assessment system for college English courses should be constructed. Wang (2009) believes that the evaluation contents include language knowledge and function, language skills, learning strategies, cultural awareness, and emotional attitude. The evaluation methods include teacher evaluation, learning portfolio, self-evaluation, and peer evaluation. The learning portfolio includes students' homework, notes, compositions, reading impressions, materials related to the background of the text, and electronic works, through which the learning achievements of each student can be displayed. Viewing from the modern language testing theory, Wu (2012) considered that in today's online teaching era, the traditional proficiency test is only a part of the College English curriculum evaluation system. Apart from that, there should be more subjective, open, and flexible evaluation methods such as observation, interviews, and student archives. Other scholars have explained from the perspective of traditional educational assessment to technology-driven educational assessment: technology has transformed educational assessment from "result-oriented" to "process-oriented", from "single examination evaluation" to "multi-dimensional comprehensive evaluation". Specifically, it makes full use of advanced technologies such as AI, big data, cloud computing, and blockchain to collect data on the whole process and all-around education evaluation, conduct in-depth data mining analysis, and feedback applications. Thus, L2 teachers can conduct multifaceted and comprehensive evaluations of the process and results of education teaching and learning, providing a comprehensive and effective decision-making basis for teaching improvement.

5. A Framework of EFL Formative Assessment with Blockchain Technology

5.1 Need Analysis

Learning a foreign language is not only the acquisition of knowledge, but also the acquisition of skills. The content and assessment methods of L2 teaching need to diversify accordingly, with increasing emphasis on assessment of students' practical English application skills. Currently, the summative assessment mainly consists of multiple-choice questions, blank-filling, judgment, and writing, which can assess the knowledge content of the language but cannot adequately meet the needs of the process assessment of language application skills. However, students' classroom behaviors, performance in extracurricular activities, speaking ability, and foreign language acquisition are not fully reflected in the summative assessment. Blockchain technology can then effectively combine EFL teaching objectives with formative assessment methods.

Current EFL teaching cloud platforms already collect and store users' learning records, but do not provide feedback on learning strategies. The data are in the hands of centralized organizations and not used effectively. Nowadays, data are the most valuable resource, and everyone should be able to get feedback on their learning from the data to achieve personalized learning. In a decentralized, entrusted system supported by blockchain technology, we can create a learning record for each learner, with a block of data for each formal learning session and a block of data for each informal learning session. An assessing system grades each student based on the blockchain of learning records, ensuring comprehensive, fair, and objective evaluation. At the same time, the

data is shared by all, so everyone can get feedback on the teaching and learning through the big data. As a result, teachers and students can choose the most appropriate teaching and learning strategies to optimize their teaching quality and language acquisition.

5.2 Overall Framework

Based on the need analysis above, this paper proposes to build a "blockchain for EFL formative assessment" based on the blockchain 2.0 architecture (Table 1) and provides blockchain services for personalized teaching and course credit certification with teaching activity records and teaching activity evaluation as the basic transactions. In the "EFL Formative Assessment Blockchain", teaching and learning activities are abstracted as an "input to output" process. The "EFL Formative Assessment Blockchain" provides a blockchain infrastructure designed in six layers: application layer, strategy layer, service layer, management layer, data layer, and network layer. The application layer is designed to generate different tasks such as teaching resources, learning records, and learning assessments by clients. The strategy layer performs intelligent calculations and pushes according to the user's identity (teacher or student) and the nature of the task, and then triggers the requests for blockchain services under the control and supervision of the system. Task requests are activated according to different policies and the service layer provides data block encapsulation. The management layer encrypts, verifies, and signs the data blocks. The data layer is responsible for digital signature, Hash, Markel Tree, and transaction. The network layer is based on P2P network, and achieves consensus or contracts through mining to link data blocks.

Table 1. EFL formative assessment blockchain framework

Structure	EFL Formative Assessment Blockchain Framework
Application Layer	Teaching resources, learning records, learning assessments, clients
Strategy Layer	Identity services, recommendation policies, access control, audit monitoring, etc.
Service Layer	Blockchain Services
Management Layer	Encryption algorithm, rule verification, digital signature, consensus mechanism, mining module
Data Layer	A Digital signature, Hash, Merkel Tree, Transaction
Network Layer	Distributed P2P network

The "EFL Formative Assessment Blockchain" consists of a teaching process blockchain and a score blockchain of all nodes. The teaching process blockchain is a private chain that records activities and assessment results during the course, while the score blockchain is a public chain that connects each student's final grade for the course as a block to the student's respective grade blockchain at the end of the course. Thus, the "EFL Formative Assessment Blockchain" is an interconnected chain made up of a combination of private and public chains.

5.3 Data Blocks

The data block structure of the EFL Formative Assessment Blockchain is shown in Table 2. Each block in the Bitcoin blockchain contains information about a Bitcoin transaction, while in the EFL Formative Assessment Blockchain Framework, each block contains a record of teaching activity and an assessment. The teaching activity is a process in which nodes invest their time, their knowledge, and teaching resources, and are rewarded in return by using the "input and output" model. The nodes are the people in the blockchain, including students and teachers. A student's status can be measured in "learning coins" while a teacher's status can be measured in "teaching coins". Teaching resources can be identified by attributes such as "relationship" "commentary", "classification" and "ownership", referring to the IEEE (Institute of Electrical and Electronics Engineers) LOM (Learning Object Metadata Specification).

Table 2. Data block structure

Block Header	Block Body
Address of the previous block, timestamp, Teaching Activities Root Hash Value, Node Status Root Hash Value	Teaching and learning activities Recording and Evaluation

Teaching activities can be divided into several categories, such as creating teaching resources, updating teaching resources, course study, and achievement tests. Each student's learning activity is recorded and graded, and the system awards "learning coins" according to a scoring mechanism. Teachers who create, update or organize resources will be added "teaching coins". The amount of "learning coins" and "teaching coins" obtained by each type of activity should be the functioning value of the attribute of the resources invested in the activity. This

functioning relationship is preset in the course design stage according to the course content and activity category.

The length of a data block can be confirmed in two modes. Take the college English classes as an example, a lesson aims at a knowledge point, and the learning process and test results are integrated into the teaching process blockchain as blocks of teaching activities, thus ensuring accurate and objective assessment of student performance. As to the informal learning activities, such as participation in English writing competitions, international academic conferences, translation volunteers for various exhibitions, etc., the length of the data blocks is determined by the rules of the Ethernet block.

The teaching activity block is organized by MPT (Merkle Patricia tree) and encapsulated in the block by hash algorithm and timestamp. Hashing is a method of converting information into a fixed length Hash value, which is irreversible, which means the original information cannot be recovered from a known Hash value. At the same time, it is almost impossible to calculate the same Hash value from different input messages. Timestamps mark the time at which each block of data is encapsulated, ensuring that the data cannot be tampered with.

The diagram of MPT is shown in Figure 2. For data records generated by a teaching activity, we can divide them into multiple data blocks, such as L1, L2, L3, and L4. To facilitate quick verification, all data (teaching activities or node status) should be hashed in groups. Therefore, the hash value hash 0-0 is obtained from the L1 data block. Since the L1 data block is only a part of the whole teaching activity (for example, a student's discussion), its hash value must be combined with the hash value hash 0-1 of other data blocks L2 for another hash transformation to obtain the hash value hash 0. Similarly, hash 0 and hash 1 need to be spliced into a string, and then the hash transformation is performed to obtain the root hash (Top Hash) of the Hash list. The root hash is placed in the block header of the block. Through this mechanism, when transmitting data in the P2P network, the next node can receive data according to the root hash obtained from the trusted data source to verify the Hash list. In the EFL Formative Assessment Blockchain, the most commonly used binary Merkle tree is applied.

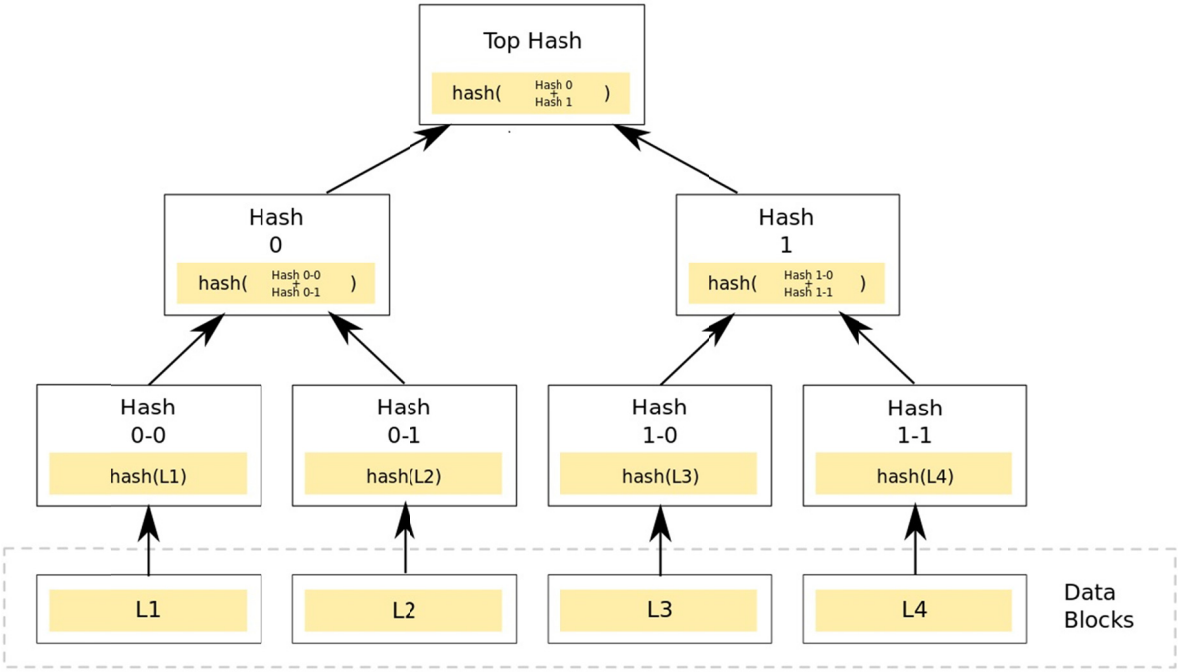

Figure 2. MPT Diagram

5.4 Operation of Blockchain

The general process of teaching activities includes four steps. Step 1: the initiator (teacher or student) sends a transaction and performs a digital signature. The system checks whether the transaction format meets the requirements of the rules. Step 2: in the verified transaction, the system judges whether the node has the transaction qualification, that is, whether the teacher or student can update the teaching resources or has the

learning foundation. If so, calculate the "teaching coins", "learning coins" and the change value of the resource attribute according to the role nature. Step 3: with the successful completion of the transaction, the transaction will occur. According to the type, the transaction will be evaluated first, and then the MPT wrapper (with a time stamp) will start. The transaction enters the data block and awaits mining confirmation. Step 4: if the data block is confirmed, the system will issue a "teaching coin" and "learning coin" to the node.

In the teaching process blockchain, the two important teaching activities are the construction of teaching resources and learning resources. Teachers upload the resources to the cloud platform, encrypt them with public and private keys using asymmetric encryption algorithms, and store them in blocks. The system automatically rewards teachers with "teaching coins". This blockchain-based teaching resource authentication mechanism can eliminate duplicate, invalid and low-quality resources, effectively improving resource quality and resource dissemination efficiency.

Taking student learning resources as an example, the specific steps are as follows. The student initiates a learning request, and the system compares the current state of the student with the preparatory knowledge of the teaching resources. If the occurrence conditions are met, the verification passes. In the process of college English class, the learning process can be recorded. After the end of this study, the students broadcast on the private chain in the course. The teacher's scoring team will evaluate the student's performance according to the process (i.e., a class), and the other nodes (i.e., all students) will record this block together. The system will add a certain amount of "learning coins" to the student according to the evaluation given by the teacher.

In the scoring blockchain, the system calculates the "learning coins" of each student according to the records in the course of learning and the final test results. The students calculate the course score according to the "learning coins" and then broadcast it on the whole network by themselves. The rest of the student nodes verify the score under the consensus mechanism.

6. Potential Blockchain Applications in the EFL Education

With the development of education informatization, every L2 learner will generate a large amount of learning data in the process of lifelong learning. The blockchain, as a data ledger, can be adapted to digital education, which can help the iteration of education development.

Firstly, personalized language learning. Blockchain has offered a new opportunity for the intellectualization of the education process, making EFL smart teaching platform more secure. At a macro level, it helps to visualize student's information, accurately depict students' data portraits, and timely offer feedback to students, parent, and school. Through data analysis, L2 teachers can precisely detect low-proficient students and give targeted solutions. At a micro level, blockchain technology promotes the furthest development of online-to-offline language education and provides learners with paths and choices for diverse education. Blockchain can adapt to the trend of EFL education development and effectively promote personalized education for learners.

Secondly, accurate assessment feedback. Assessment is not only the embodiment of the application value of educational evaluation, but also an essential part of the evaluation. Through highly personalized customization, an intelligent recommendation engine, and other technologies, the assessment results are timely and accurately pushed to learners in the form of interactive visualization to effectively promote management and learning. Assessment feedback runs through the whole linguistic learning activities. There are procedural real-time feedbacks, such as pre-class evaluation and in-class real-time detection feedback. It can accurately push language teaching and learning resources based on the assessment results, so teachers can choose the appropriate information technology to assist in teaching flexibly, and satisfy the learners' needs for ubiquitous learning and self-adaptive learning (Gong, 2022).

Thirdly, the reliability of credit banks. The intertemporal power of education has been further enhanced, and the "Semi-School" is gradually taking shape. In the future, as credit banks become more mature, especially with the mutual recognition of international credits, learners will no longer be confined to a fixed mode of learning but will be able to learn more freely across regions and countries, accompanied by the sharing of quality educational resources. Thus, the label of a fixed school on learners will fade slowly. School management is becoming smarter and more efficient, international education collaboration is becoming more and more convenient, and learners are becoming less dependent on schools or other educational authorities. The use of blockchain will further release the vitality of education, repositioning the role of schools and other educational institutions to become "Semi-schools" and increasing the productivity of new knowledge.

7. Conclusion and Outlook

In summary, thanks to the intelligent learning system, EFL practitioners should use modern information

technology to assist their language teaching. We use big-data learning analysis technology to capture students' learning process data and boldly carry out the teaching reform. Blockchain is more adapted to the current trend of learners' diverse learning needs and provides autonomous learners with convenient, free, safe, reliable, and personalized educational services. Its currency properties have the potential to trigger many innovative applications for education. By realizing "learning is earning," blockchain technology can foster students' learning motivation. Overall, blockchain is applied to construct a balance to measure the learning processes and outcomes. It is a reliable and equal proof of value for everyone. For learners and teachers, blockchain has great potential applications in behavior recording, course design, study analysis, and formative evaluation. Therefore, we strongly recommend that EFL practitioners utilize this technology to store a complete, trustworthy set of records of educational activities, including the processes and results in formal and informal learning environments.

Based on this blockchain technology, we can realize the distributed storage and recording of the learning process and academic achievement and provide strong support for credit certification, thereby exploring the possibility of cultivating more advanced language talents. At present, application of blockchain technology in teaching is still in its infancy. Relevant research mainly focuses on storage and recording of learning content and achievements. Therefore, the "EFL Formative Assessment Blockchain Framework" constructed in this study is a prospective exploration. It reconstructs the new paradigm of teaching and learning in L2 education and needs iterative optimization in practice. Hopefully, this study will provide a new direction for the assessment method of EFL education and create a new prospect for teaching reform.

The distributed ledger technology creates a new relationship between individuals, educational institutions, and employers. The data that documents, verifies, and shares the learning individuals gain throughout their lives. As a society and economy, we must ensure these improved opportunities to learn for all learners, preserve evidence of all quality learning, ensure equitable use of learning data, and empower learners to use their data to pursue a prosperous life and promote economic growth. In the consensus-driven spirit of blockchain, we can achieve these aspirations together (American Council on Education, 2020). Equality means the equal rights and opportunities that everyone should have on a blockchain network. The openness, borderless, and permissionless features of blockchain technology can provide everyone equal access to the technology.

The transparency feature is strong protection for teachers who have fulfilled their duties. Teachers' and students' behaviors are recorded and monitored in blockchain technology. The trust between the subjects is based on technology itself instead of the third party. Hence, the school administration can objectively evaluate the faculty's teaching quality and trace their teaching activities to achieve smart governance.

For linguistic researchers, blockchain has great potential to be broadly applied in EFL/ESL scenarios. It would be challenging to conduct research like, How do L2 practitioners utilize the digital currency property to enhance learning motivations and achievements? As for technology developers, they may consider how to apply blockchain to education. It is necessary to develop educational platforms and software to meet the users' personalized needs.

As to the future research direction, some theoretical issues also need to be investigated further. There should be a clear boundary between information sharing and data privacy. Breaking the data island through consensus computing also requires the active participation of many enterprises. Blockchain is a powerful and efficient application, and our understanding of its importance in school information construction needs to be improved. The problems of fraud and resource closure in the traditional education field can release the vitality of education more efficiently through the application of blockchain. Although blockchain has unparalleled technical advantages, when it is applied in the traditional education, it also needs to be treated calmly, constantly optimize its characteristics and improve the external environmental conditions to embrace greater challenges and provide better educational services for learners in the future.

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