A Perspective of Blockchain Technology in Academic Bank Credit Accumulation

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ABSTRACT

Blockchain technology enables the creation of a decentralized environment, where transactions and data are not under the control of any third party organization. Any transaction ever completed is recorded in a public ledger in a verifiable and permanent way. Based on the blockchain technology, we propose a global higher education credit platform,. This platform is based on the concept of the Higher education Institutes Electronic Credit Transfer and Accumulation System (ECTS). It constitutes a globally trusted, decentralized higher education credit, and grading system that can offer a globally unified viewpoint for students and higher education institutions (HEIs), as well as for other potential stakeholders, such as companies, institutions, and organizations. As a proof of concept, we present a prototype implementation of the environment, based on the open-source Ark Blockchain Platform. Based on a globally distributed peer-to-peer network ECTS will process, manage, and control tokens, which represent credits that students gain for completed courses. HEIs are the peers of the blockchain network. The platform is a first step toward a more transparent and technologically advanced form of higher education systems.. The Credit Transfer and Accumulation System refer to a system that collects stores and manages students' academic performance and credits. It allows students to transfer credits between different educational institutions and training institutions, providing convenience for lifelong learning and career development. However, the traditional credit transfer system has problems with data security, reliability, and authenticity. Blockchain technology has the characteristics of high reliability, traceability, non-tampering, and decentralization. Therefore, we propose to build a credit transfer system based on blockchain technology.

Keywords: Blockchain, High reliability, Traceability, Non-tampering, Decentralization higher education institutions, ECTS, tokens.

1. Introduction

Based on the concept of the Electronic Credit Transfer and Accumulation System (ECTS) we propose a global blockchain-based higher education credit platform. The proposed system will exploit the benefits of the blockchain, as a decentralized architecture, offering security, anonymity, longevity, integrity, transparency, immutability and global ecosystem simplification, in order to create a globally trusted higher education credit and grading system. The scientific contribution is to provide a distributed and interoperable architecture model for the higher education credit system which addresses a globally unified viewpoint for students and institutions. Potential employers can benefit from the proposed system. Students can take advantage of having their completed course history in a single and transparent view, as well as universities which have this data accessible and up to date, regardless of a student's educational origins. On the other hand, different organizations (such as employers, universities, etc.) as potential users of the system, can validate the provided information after a student's permission is obtained. Electronic Credit Transfer and Accumulation System (ECTS) refer to a system that collects stores and manages students' academic performance and credits. It allows students to transfer credits between different educational institutions and training institutions, providing convenience for lifelong learning and career development. The Electronic Credit Transfer and Accumulation System (ECTS), allowing students to study at different times, different locations, and different education or training institutions, and accumulate the credits earned. At the same time, students can transfer earned credits from one institution to another. The Electronic Credit Transfer and Accumulation System (ECTS) provide students with a more flexible learning path. Students can choose different courses and training projects according to their interests and career plans. The credit bank system supports the concept of lifelong learning. No matter what stage students are at, they can continue studying and save the credits they earn in the credit bank. The credit bank system supports a variety of different learning models, including traditional face-to-face classroom learning, online learning, hybrid learning, etc. To ensure the quality of credits, Electronic Credit Transfer and Accumulation System (ECTS) usually have a complete set of quality assurance and certification mechanisms.

A. MOTIVATION

The majority of higher education institutions (HEIs) keep their students' completed course records in proprietary formats. These databases are structured to be exclusively accessed by an institution's staff and in dedicated online systems, hence with little or no interoperability. Furthermore, the majority of institutions have their own specialized system for keeping students' completed course records, which preserves the proprietary data structure of the database. In general, these databases are hosted in a data center inside the HEI, with restricted access to its IT professionals. Students can have external access to their data in a restricted, password protected manner, only to view or print their completed course records (some systems enable and log students' online check-in and check-out exams). There are several vital points in regards to such systems, including standardization of data, storage location, safety and how to filter, analyze and securely share such data. Connected with these

issues, HEIs maintain the students' completed course records indefinitely. This is required for legal reasons, depending on a country's policy. Also in the majority of cases, institutions do not share their students' data, not even the completed course records. Hence, students can experience difficulties transferring to another HEI, while still preserving and proving their completeness of courses from the previous institution. This problem is even more vivid in cases when a student wants to transfer to another country, where a language, script and administrative barrier exist. Moreover, these records are usually stored in different standards, which make it difficult to exchange records between HEIs.

In cases when the student applies for a job position and has to prove his/her academic degree in a foreign country, problems arise from the centralized storage of students' complete course records due to their inaccessibility, lack of standardization, etc. The students have to translate and recognize their academic certificate which can be a complex and time- consuming process. The recognition process includes the translation of all official documentation into the language of the host institution, which has to review and validate every aspect of the documentation in order to examine matching or diverging content.

Furthermore, after completing their education, students sometimes have no access to the online academic grading system. In such a case, if a student loses his/her academic certificates, he/she needs to visit their home HEI and request a new copy, which can be a costly and time consuming process.

2. Literature Review

Over the past few years, the potential application of blockchain technology in education has become the focus of many researchers.In terms of school credit and certificate certification, many researchers have explored how toleverage the immutability of blockchain to create a safe and reliable authentication system. For example, Prinz and Koch Grech [1] proposed a blockchain-based open certificate system that can provide transparent, verifiable and durable academic records. In order to solve the transfer and mutual recognition of credits, Sharples and Domingue [2] discussed how to use blockchain technology to simplify this process and provide a decentralized and automated solution. In order to solve the problems of traditional closed credit management system and limited data access, Chen et al. [3] studied how to use the transparency characteristics of blockchain to improve the accessibility of data while protecting students' privacy, and better Addresses issues of data transparency and accessibility. Turkanović et al. [4] explored a blockchain-based learning archive management system that can provide students with a lifelong, comprehensive learning record. Azaria et al. [5] proposed a solution to the problem of preventing forged certificates and credits through a blockchain-based certificate verification system. Schmidt et al. [6] explored how to reduce the high cost of traditional credit management and certification methods by automating the credit transfer and certification process. In order to achieve mutual recognition and transfer of credits, Condie and Hillaire[7] analyzed the current credit management standards and proposed a standardized framework based on blockchain.

As a revolutionary technology, blockchain has attracted the attention of a large number of scholars and engineers since the birth of Bitcoin in 2008. Narayanan et al. [8] discussed in

detail the important role of cryptographic hash functions in ensuring blockchain data integrity and tamper resistance. Cachin and Vukolić [9] conducted an in-depth analysis of several main consensus mechanisms in blockchain, such as Proof of Work (PoW) and Proof of Stake (PoS), and implemented distributed protocols and guarantee systems in blockchain networks. Key technologies for consistency. Christidis and Devetsikiotis [10] explore the design principles and application of smart contracts in implementing automated business logic, allowing automated, trustless transactions and operations to be performed on the blockchain. Zyskind et al. [11] proposed several data privacy protection schemes based on blockchain, which to a certain extent solved the challenges that the openness and transparency of blockchain bring to data privacy and security. Swan [12] analyzed the basic principles and potential applications of distributed ledger technology from a macro level and solved the problems of distributed ledger technology, which provides a decentralized data storage and management framework. Miller et al. [13] discussed the technical challenges and solutions for on-chain and off-chain interactions, and the key technologies for realizing the connection and interaction between blockchain and the real world.

As can be seen from the above literature review, the application of blockchain in the field of education is still in the exploratory stage, but it has shown great potential. How to comprehensively integrate the advantages of high reliability, traceability, non-tampering and decentralization in the development of specific information systems is still a challenge. Only by solving the above problems can an efficient credit bank system based on blockchain technology be developed.

Blockchain technology aims at creating a decentralized environment where no third party is in control of the transactions and data [3]. It is used in several domains due to its benefits in distributed data storage and the possibility of audit trails. In healthcare, several approaches have been introduced in the field of electronic health records (EHR) [4]–[10]. Clinical trials or data access and permission management are fields in which the technology can be applied [7], [10]. Closely related to EHRs is interoperability, where blockchains have also been employed [6], [8]. Some authors even claim that it could revolutionize healthcare [9]. They give examples as smart and public healthcare management, which can benefit the patient, by using blockchain technology to fight counterfeit drugs in the pharmaceutical industry.

However, healthcare is only one of the possible blockchain application domains. Due to the transparency of the technology, the domains of government and business also try to apply the technology and harvest its benefits [11]. The blockchain is applied in e-government scenarios [11], smart government [10], etc. In the business domain new concepts and systems arise (e.g. electronic cash systems, business processes, etc.) [6]–[8].Even in logistics and transportation blockchain technology can be applied [9], . In this way, new intelligent transportation systems are developed. Additionally, energy production, management and trading can foster the benefits of the blockchain [1]–[3]. Smart grids and different smart technologies can employ the technology to optimize their operation [3] and new business opportunities can be developed [2]. The blockchain technology can also be applied in higher education. Several higher education’s institutions have employed the blockchain technology to design different solutions and approaches related to higher education. The majority of solutions use the Bitcoin blockchain [3], [4]. NazarÃÉ et al. have proposed a platform for

creating, sharing, and verifying blockchain-based educational certificates within the scope of the Digital Certificates Project. This incubation project is based on the Bitcoin blockchain and is lead by the Media Lab Learning Initiative at the Massachusetts Institute of Technology (MIT). This approach addressed the issues of digitizing academic certificates and does not investigate the possibility of the block chain to be used in a global higher education credit and grading platform. In 2016, the Parisian Leonardo da Vinci Engineering School (ESILV) announced it would certify diplomas on a bitcoin blockchain [7]. They have partnered with the French Bitcoin startup Paymium, but no further details or a prototype have been published so far. There are also other higher education institutions, which have or intend to use the blockchain technology. In 2015, a software engineering school in San Francisco, the Holberton School, announced using the technology to help employers verify academic credentials [8].

Most of the aforementioned projects in the higher educa- tion domain rely on closed concepts or ideas and often do not discuss details or even remain on an idea level. Some of the related projects are offered exclusively to a closed circle of entities.

3. BLOCK CHAIN PLATFORM

This section outlines the proposed platform ECTS, a blockchain-based higher education credit and grading platform. An abstract depiction of the platform on a higher level is presented in Fig. 1. The blockchain platform is envisioned for processing, managing and controlling ECTS tokens as academic credits and resting on a globally distributed P2P network, where peers of the blockchain network are HEI and users of the platform are students and organizations (e.g. companies as potential employers). The ECTS tokens represent an equivalent to student's credit value for completed courses, as with the ECTS credits students gain (see section Electronic Credit Transfer and Accumulation System). Each student will hold a dedicated ECTS blockchain wallet, where he/she will collect ECTS tokens, i.e. the value of credits assigned by the HEI for his/her completed courses. Every time a student completes a course, his/her home HEI will transfer the appropriate number of ECTS tokens to his/her blockchain address.

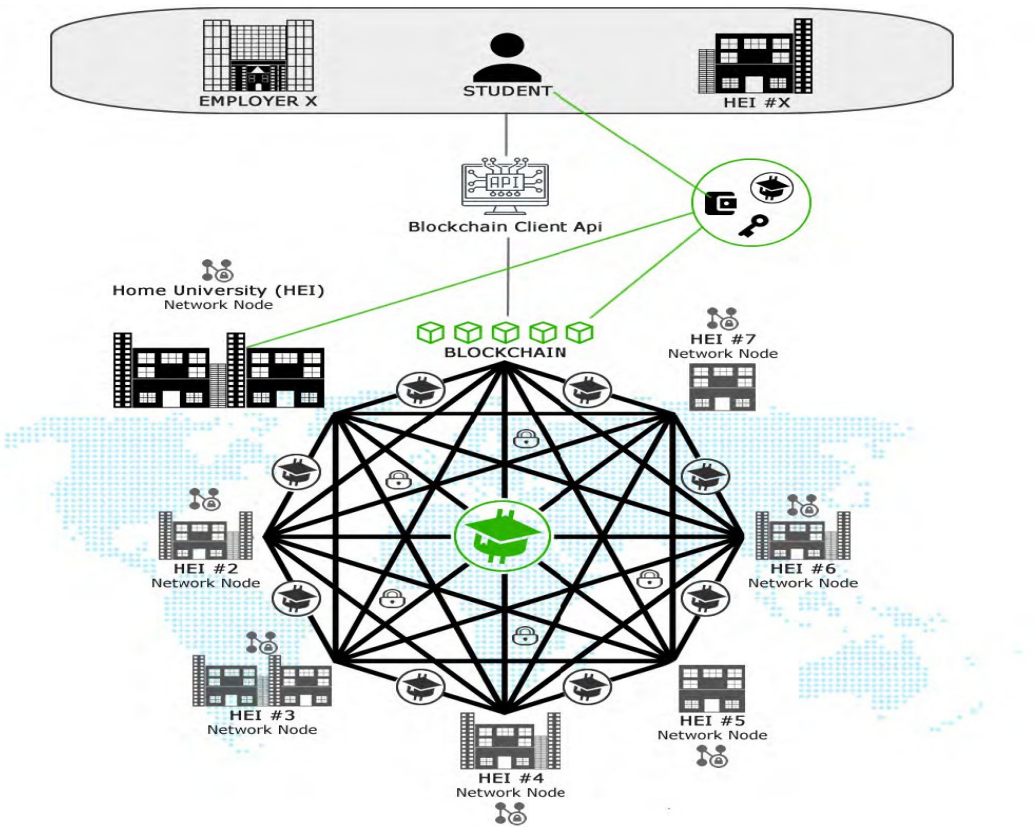


FIGURE 1. Depiction of the Block chain platform for ECTS.

The transfer information is stored on the blockchain, where the following data is stored: (1) The sender is identified as the related HEI with its official name, (2) the receiver - student is anonymously presented, (3) token - course credit value, and (4) course identification. Furthermore, using his/her blockchain address, the student as the receiver of ECTX tokens, will be able to globally prove his/her completed courses, without any administrative, script or language obstacles by simply presenting his/her blockchain address. The blockchain-based credit banking system aims to provide a safe, transparent and credible credit management and certification platform for the education field. The design of the system needs to consider various technical and business requirements. We conducted a comprehensive design from system architecture, data storage, transaction packaging, blockchain updates, and user interface and data model

4. Academic Bank of Credits:

It is an online Virtual or digital storehouse that stores the credits of the students earned in the process of their studies in Indian Universities. The students earn credits from their studies and the parent registered Institution will deposit the credits in the ABC account of the student. It helps the students to have multiple options to join and leave various institutions, and the credits earned can be transferred to other institutions. The purpose of ABC is to make students skilful professionals. It validates offline and online courses such as NPTEL, SWAYAM, and V-Lab. If implemented successfully it can be a game-changer.

Objectives of Academic Bank of Credits:-

The main objectives of ABC are

➢ To promote the child-centric education

➢ To emphasize the learner-friendly teaching approaches

➢ To follow an interdisciplinary approach

➢ To allow students to opt for the courses of their choice

➢ To opt for the best teachers for the chosen subject

➢ Help students to study according to their own pace

ABC encourages an open educational system that guarantees' students' academic growth and development. The student secures credit with courses he completes and it gets transverse when he shifts from one institution to other to pursue higher education by enjoying multiple entries and multiple exits. ABC is a virtual platform maintained by UGC with the approval of the central government. There are different types of courses under the ABC scheme where credits are deposited.

Role of Academic Bank of Credits:

ABC has to perform the following functions as mentioned below.

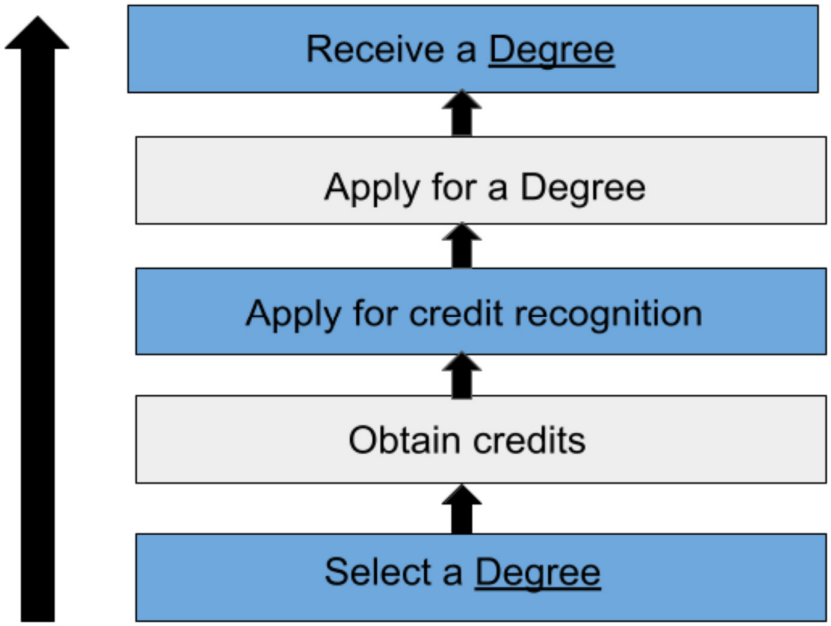
1. **Credit accumulation**:-It is the facility given by ABC to the students of HIEs to consolidate and transfer credits earned by the student while undergoing the course.

2. **Credit recognition:-**It is the process where ABC recognizes the credits earned by the student during the course in higher educational institutions.

3. **Credit Transfer**:-It is the transfer of credits of the students earned while pursuing the course in one higher education instruction to another higher educational institution.

4. **Credit redemption**:-It is the process of reclamation of credits earned by the students to get a degree, diploma, or certificate course.

Process of Academic Bank of Credits:



Benefit of ABC for learners:

- It offers multiple entry and exit option to the learner.
- It provides the option of transfer of earned credits to the learners on pursuing courses of their choice and interest.
- It helps the learners enjoy academic Flexibility and freedom.
- It is a step towards promoting inclusion of all learners.
- It will enable students to study and engage in a course/s based on their interest, need and choice.
- It will help in the transfer, accumulation, and redemption of credits.
- It gives freedom to learners to choose institutions of their choice.
- It will help learners to select the pace and timing of the course as per their need.
- It promotes student-centric and friendly approach in the higher educational levels of our academic system.
- It encourages the learner to pursue and work towards earning their degree as per their chosen time preferences.
- It will support students to choose courses of certain specializations instead of undergoing the traditional prescribed courses.
- It supports student mobility across specializations and levels of courses such as certiflcate, diploma, degree and Post-graduation.

- It supports Life Long Learning (LLL).
- It will support continued education among adult learners, and drop-outs seeking additional training, skill development alongside pursuing an academic degree.
- It will act as an academic repository which will be the storehouse of all digital academic transcripts and records issued by a recognized organization and institution.
- It is like an 'open educational system' which will facilitate the recognition and inclusion of diverse learners and diverse learning experiences gained at home and school.
- It will further lead to the progression of the Indian educational system providing it a global transformational outlook and producing global, self -achieving learners matching world standards.

5. Summary and Outlook

This study conducted in-depth discussion and practice around the design and development of an academic credit banking system based on blockchain technology. By analyzing the principles and core technologies of blockchain technology, as well as researching the challenges faced by the existing credit banking system, we designed and implemented a blockchain-based credit banking system. This system effectively solves the problems of data in consistency, lack of trust and inefficiency existing in the traditional credit banking system by leveraging the immutability, transparency and smart contract functions of the blockchain.

6. Future outlook:

(1) With the further development of blockchain technology, the scale and efficiency of the system can be achieved by introducing more efficient consensus mechanisms and data processing technologies in the future.

(2) By adopting more advanced front-end technology and interaction design, the user experience and interactivity of the system can be further improved.

(3) Good security and privacy protection. By applying encryption technology and permission control mechanisms, we have achieved system security and privacy protection, ensuring the security of user data.

(4) Using big data and machine learning technology on the blockchain, more intelligent data analysis and credit recommendation functions can be implemented in the credit bank system in the future.

7. In summary, the blockchain-based academic credit banking system has broad application prospects and unique advantages. Through further research and development, we are confident that we can promote the practical application of blockchain technology in the field of credit management and certification, and contribute to the innovation and development of the modern education system.

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