

A blockchain based lifelong learning platform: The Smart University

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ABSTRACT

According to today's education system, the content, applicability, quality and performance measurement criteria of the courses may vary according to countries, educational institutions and educators. Because of incorrect performance measurement, hidden skills disappear before they appear. Thanks to the graduation diploma it is observed that people with less professional knowledge and skills come to better places than those who are more knowledgeable and skilled. In addition, due to the lack of a proper training plan and long periods of education for the target learning community, boredom and financial problems may arise. In this study, a blockchain-based lifelong learning platform whose content, processing, reliability, decentralized, open to continuous and rapid accessibility, and evaluation criteria and method is completely objective is proposed while trying to avoid material and temporal problems. Thanks to this platform, the diplomas to be received by the students who have successfully passed the end-of-education exams will be time-stamped, immutable, safe and traceable. At the same time, all these documents, storage of training contents, diplomas, certificates, post-training exams and all related files, will be kept accessible, secure and immutable thanks to IPFS, the Inter Planetary File System. Achievements, employer and employee pools to be created according to the achievements, and recruitment contracts to be realized will be controlled by smart contracts and absolute reliability and objectivity will be ensured. All these concepts will be made available through a decentralized application (DApp) which will run on a private blockchain network that requires a partial permission to be established.

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1. Introduction

Education is known as an important field of study that is open to development and change in the process from past to present in terms of its content and outputs. According to the classical education methods, the quality and duration of the education may vary as well as the people who teach at the same courses in schools with the same curriculum and the same subjects. The most important aspect of the educating process is the quality of the educating provided. This requires individuals to respond to the needs and demands of the society at the desired level with the knowledge, skills and experience acquired in line with the education they receive [1]. These changes, which can be observed in the quality of educational institutions, may also vary in the examinations conducted and the evaluation of these exams in order to determine how much the trainees have learned from education and how much they can apply. To summarize, there is no generally accepted infrastructure for educational institutions to carry out their training and to test the people who receive the training [2]. In addition, when

people want to study at a university after graduating from a university, they repeat the previous processes. Again, these people wait for the dates specified in the academic calendar to start their education and any other related processes. Because all of these procedures are distracting and time consuming, people are distracted from studying and documenting their competence in that field.

Due to the weakness of the education system and the lack of measuring capabilities, people may not be able to discover their real hidden areas of interest or qualify for training in institutions providing specific interests [3]. As a result of such situations, people would not have a diploma to document their skills and knowledge, they cannot rise in the institutions they work because of some legal regulations and cannot get the money they deserve in return for their labour. As a summary, it is seen that the person is more educated than the employed position required. [4].

In this study, a blockchain based lifelong learning platform was proposed as a solution to these shortcomings. With a university to be implemented on this platform, the professional knowledge competence of the people who receive equal training in terms of content, method and quality will be determined by smart contracts on this blockchain based platform. In this way, subjective professional knowledge measurement and assessment will be replaced by an objective assessment, while unjust progression, rise and income based on evaluation will be eliminated. Since the data recorded in the blockchain is time stamped, the education contents and diplomas can be tracked backwards and transparently. Thanks to its blockchain tamper proof feature, any positive or negative interventions to educational contents or diplomas will be prevented strictly.

2. Method

At the present time, the data about the trainings and final exams given by universities or recognized educational institutions around the world are stored centrally. Central storage of data undermines confidence in data privacy, security, and non-changeability. The request for instant access to data may be delayed at high request moments and cause the data to be completely inaccessible for a certain period of time due to a possible technical failure [5]. In this study, blockchain technology, decentralized applications running on blockchain (DApp) that associated with smart contracts and Inter Planetary File System (IPFS) as a storage environment are proposed as solutions for such situations [5].

a. Blockchain

Blockchain is a distributed ledger technology in which the transactions that are required to be kept in record are encrypted and stored in structures called blocks. In this distributed ledger, the blocks are linked chronologically to form a chain of blocks. The first block in the chain is called the Genesis block. Each block after the Genesis block contains the encrypted information of the preceding block. In this way, all blocks in the blockchain can be accessed retrospectively [6]. Blockchain is not a database. Because in blockchain logic, there is no way to edit or delete any data you added before. In addition, all transactions with blockchain records contain timestamps. This is a crucial feature for reliability and confirmability.

b. Smart Contracts and DApp

According to Szabo, smart contracts are digital contracts, which are the digitalized version of classical contracts that operate when the necessary conditions are met [7]. In the context of blockchain, smart contracts are scripts stored on the blockchain. It is not possible to run smart contracts on every blockchain platform, as well as blockchain platforms such as Ethereum, Hyperledger Fabric, NEM, Stellar, iOLite, Neblio, and Lisk. To upload a smart contract to the blockchain, Ethereum runs a special creation transaction that identifies the

contract to the blockchain. At the end of this process, a contract account is created and a unique 160-bits address is assigned to this account. After these processes have been completed, the code of the contract is deployed to blockchain. From this moment it is not possible to intervene in the smart contract [8]. If a change in the contract is desired, only the modified version of the contract can be uploaded to the blockchain, which means creating a new 160-bits contract account with a unique address. Different contract or wallet accounts can then interact with them by sending contract-calling transactions to known contract addresses.

Unlike today's centralized web or mobile applications (Web 2.0 - CAPP), DApps are transparent, distributed, flexible, decentralized applications that do not run on a central server or machine with better incentive structure [9]. The data used by such applications is also kept in a blockchain in a decentralized manner like the application itself. In this way, in case of failure of a web server seen in conventional systems, the period of inaccessibility of the application will be overcome. Since the applications will run in a decentralized blockchain network, any disappearance of machines will not cause the application and related data to be inaccessible. Examples of the decentralized counterparts of today's popular central practices are given in Table 1.

Table 1. Centralized Applications and Decentralized Counterparts

	CAPP	DAPP
Browsers	Chrome, Firefox	Brave
Storage Services	Dropbox, Yandex Disk	Storj, IPFS
Video and Audio Calling	Skype, Google Voice	Experty
Social Network	Facebook, Twitter	Steemit, Akasha
Messaging	Whatsapp, BIP	Status
Operating Systems	Android, IOS	EOS, Essentia.One, Nynja
Home Office Platforms	Up, Bionluk	Ethlance

c. IPFS

IPFS is an end-to-end (P2P) hyper-media protocol that is being developed to make the web more transparent, faster, and more reliable, with the ultimate goal of replacing HTTP [10]. According to the Hyper-Text Transfer Protocol (HTTP) used in today's web, a file that is desired to be downloaded is downloaded from only one computer. However, this file can be downloaded in pieces from multiple computers at the same time. IPFS makes it possible to distribute large volumes of data with high efficiency.

Using IPFS and blockchain together, data can be stored in IPFS according to the blockchain philosophy. In a transaction that will be registered to blockchain about this data, only permanent non-modifiable cryptographic IPFS links can be stored to represent the data. [11]. Since each file in the IPFS system and each block that forms this file consists of a cryptographic hash value, and the blockchain is timestamped, the data will not need to be kept in a chain.

d. Operating of the System

The system consists of the member educating institutions that will form a special blockchain network that requires partial permission, a DApp that will run on the blockchain network of these training institutions and interacts with smart contracts, and the IPFS components where all the data such as diplomas, participant information will be kept, as well as training, exam contents. This blockchain network is a special blockchain network that requires partial permission, since the institutions to be included in the system will be selected and identified, but no member participating in the network will need to obtain permission for block writing and transaction validation [12].

In Turkey, it is planned to use Blockchain Research Network (BAG) blockchain, being established in TÜBİTAK BİLGEM coordination, for the running of this Smart University platform. That blockchain is under construction. The Smart University DApp Application will be developed to run on this semi private blockchain network. Through this application, the world-wide accepted educational contents of the student will be stored on IPFS. The results of the exams to be determined by smart contracts and the diplomas to be obtained upon graduation will also be kept on this IPFS. By shifting the data load to IPFS and using only cryptographic IPFS links in the blockchain, the scalability problem of the blockchain will be overcome.

According to the lessons received by the learner and exam results, the potential employee pool for employers and the potential employer pool for students will be realized through smart contracts. In the event of a possible recruitment process, the contract to be signed by the parties will again be a smart contract, preventing unfairness and data monopolization which may make employer institutions advantageous in case of a dispute. In addition to all these opportunities, if this system is accepted globally, it will not be necessary to study for years to obtain a diploma and the student who has reached sufficient maturity and knowledge will be able to get started without unnecessary waiting. The operating of the blockchain-based lifelong learning platform is schematically illustrated in Figure 1.

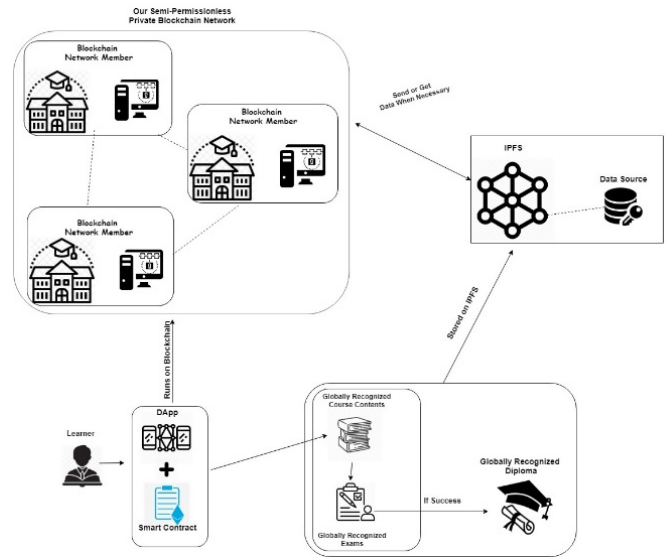


Figure 1. The Smart University Operation Flow

3. Discussion and conclusion

Blockchain technology and other related technologies that have started to develop with this technology have not been fully accepted in our country yet and will take time to be accepted. In addition, the IPFS structure is not yet stable and will take time to become stable. The Blockchain Research Network blockchain is under development by TÜBİTAK BİLGEM and it will take some time to finish the development and make it stable. A standard for the creation of globally recognized educational contents, end-of-education examinations, and selected institutions that will produce content and exam questions according to this standard should be identified. These institutions should have incentive awards in return for their efforts. In this system, a system-specific crypto currency can be generated and used to purchase training. It is possible for all educational institutions that recognize this system to accept and apply for the undergraduate diploma of the students who will apply for postgraduate education, and for employers to be able to recognize and receive this diploma. The tamper-proof and time-stamped properties of the blockchain will eliminate the possibility that the diplomas are false or fake. Since the achievements in the courses will be taken into consideration while creating the target employer, employee and workplace pool, it is aimed to improve the labour-performance harmony between employer and employee according to today's conditions.

The positive or negative aspects of conducting the trainings in the classroom or online have been observed through some researches [13]. The fact that the exams are held online allows the exam questions to be easily copied and stored to make higher grades in next exams. As a result of this situation, it may be necessary to create different exam questions for each

student who takes the same course at the same or different times and will take the exam at the same or different time. This problem can be solved in a way that the lessons can be taken at various times but the exams can only be held at certain times. There are courses that are appropriate for online training and performance measurement, as well as courses that are inappropriate, requiring laboratory practice and group work. Students who are interested in these courses and want to work in related fields may not be able to get full efficiency from this platform.

4. Future works

The ultimate goal of the Smart University platform, which is planned to be tested among the selected pilot training institutions (BAG members) and employers, is to become acceptable to all educational institutions and employers in the country. After achieving country-wide acceptance, smart university platforms can be linked to other countries. Block chain networks running on these platforms can communicate with each other to ensure a worldwide data integrity. Ensuring the integrity of this data means that there are people with recognized diplomas worldwide. In this way, people's knowledge can easily be accepted by other countries which recognize this platform as a global quality.

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