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Blockchain For Educational Certificate Distribution

by
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Bachelor of Science
King Khalid University
2014

A thesis submitted to the
College of Engineering and Science at
Florida Institute of Technology
in partial fulfillment of the requirements
for the degree of

Master of Science
in
Computer Information Systems

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We the undersigned committee hereby recommend that the attached document be accepted as fulfilling in part the requirements for the degree of Master of Science in Computer Information Systems.

“Blockchain For Educational Certificate Distribution”
a thesis by Layla Asiri

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Abstract

Title: Blockchain For Educational Certificate Distribution

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There are many authenticity problems associated with paper certificates and diplomas. Besides the increase in the forgery of paper certificates and diplomas, other quality problems regarding paper certificates and diplomas deserve attention too. This study seeks to evaluate how alternative technologies may mitigate concerns for Florida Institute of Technology students and faculty and determine whether they support the adoption of Blockchain technology. In particular, this research aims to investigate the challenges of using Blockchain technology for issuing and verifying academic records, certificates, and diplomas for Florida Institute of Technology students and faculty. Blockchain technology can be difficult for institutions to integrate and presents additional costs but may provide extra security for student documents. Even if the long term persistence properties are not yet known based on many years of experience, which could generate limits in user trust, we find that the majority of potential users are positive about the potential of Blockchain technology.

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Dedication

This thesis is dedicated to my parents who raised me to be who I am today.

Chapter 1

Introduction

1.1 Introduction

Certificates and diplomas are both earned as a result of attending college and it's important to have certificates and diplomas when applying for a job. Certificates/diplomas are not just a piece of paper; these documents are proof of graduating from a university or college and having specific skills. Typically, the certificates/diplomas are produced on paper and that has some drawbacks. Paper certificates and diplomas need to be manually issued and verified; this process can be time-consuming. Unfortunately, there is a real problem with counterfeit paper certificates/diplomas which can be purchased from mill diploma websites. The increasing mill diploma websites affect the credibility of academic degrees and fake certificates/diplomas are easy to obtain.

Technology has changed our world and the expected future will rely on technology.

New technology, called Blockchain technology, was recently developed. Blockchain technology has attracted the attention of researchers and developers and they have applied this technology in different fields such as finance [27], healthcare [9, 12], banks [29], and education [26]. The Blockchain technology [1], known as Distributed Ledger Technology (DLT), is related to databases and enables a high level of security. The benefit of Blockchain technology is that the digital asset history can not be changed because the usage is cryptographic hashing.

This study seeks to evaluate the challenges of using Blockchain technology for issuing and verifying academic records, certificates, and diplomas for students at Florida Institute of Technology. This study will identify problems that students might face after they graduate with their paper-based certificates/diplomas. Additionally, student's level of understanding and opinion about Blockchain technology will be evaluated.

1.2 Research Questions

Education motivates learners to face challenges and increases faith in their capabilities. This process also enables students to acquire tools of knowledge and skills to increase their self-responsibility, personal success, and family, and in terms of study, work, and achievement. Certificates/diplomas are proof that students have acquired knowledge and skill in a field. The main stages for the study are the following:

- Investigation of the FIT students' level of understanding of Blockchain .

- Investigation of the FIT students' opinions about the adoption of Blockchain technology to issue and manage their certificates/diplomas.
- Identification of the problems that FIT students might face with a paper certificate rather than an electronic version.
- Discussion of the prior studies that apply the Blockchain technology in the education sector.
- Discussion of the existing applications and platforms that are launched to store the academic record, certificates, and diplomas.

1.3 Problem Statement

There are several problems that have been identified in this project. The core objectives of this study are to evaluate the challenges of adopting Blockchain technology for issuing, managing and verifying certificates/diplomas at Florida Institute of Technology.

- The study will identify the problems that students might face with their paper-based certificates/diplomas after they graduate.
- The study will identify how the Florida Institute of Technology currently issues and verifies the certificates/diplomas, and what are the Florida Tech staff personal opinions about Blockchain technology.

1.4 Research Outline

This study is organized as follows:

- Chapter 1 provides an introduction about the research, introduces the research question, and problem statement.
- Chapter 2 provides the background of Blockchain technology and an overview of fake diplomas.
- Chapter 3 introduces the related work, discussing prior studies that proposed Blockchain technology as a solution in the education field as well as some of the current projects that are already being employed for managing students' academic records.
- Chapter 4 describes the methodology of collecting data.
- Chapter 5 summarizes for the results.
- Chapter 6 conclusions, and the study result .

Chapter 2

Background

2.1 Fake Diploma

The fake diplomas have become a dangerous threat to the credibility of education. In 2018, BBC News has published an article about a software company in Pakistani called Axact which was based on and selling fake certificates and diplomas [9]. Axact earned about 51 million from selling around 215 fake diplomas [9]. BBC discovered that there was a list of people in the UK who bought fake diplomas for different purposes from the Axact company. Allen Ezell, former FBI agent said, “We live in a credential conscious society around the world. So as long as paper has a value, there is going to be somebody that counterfeits it and prints it and sells it” [9]. Furthermore, a newspaper discovered that the LinkedIn network contained thousands of fake resumes and fake degrees [1]. Many people adjust their resumes to make them seem perfect; similar to how pictures on social media are filtered.

2.1.1 The Important Reasons for Fake Diplomas

- **Diploma Mills**

Diploma mills are websites that sell fake degrees and lack accreditation and “licensing from known universities and colleges [25]. In the last decade, degree mill websites have become widespread; degrees are sold and shipped to buyers in four or six business days without the recipients ever showing up to classes.

- **The cost and time of earning degrees**

Other than pure dishonesty, it is claimed by these sites that one of the reasons behind selling and buying fake degrees is some people believe that their life experiences are adequate to earn a diploma. The other reasons are the high tuition costs to get the degree, and that the time to go through the process is too long.

2.2 Blockchain Technology Concept

The Blockchain is a technology that enables a set of participants to jointly maintain a database of items based on a particular type of consensus. This consensus stems from the need of having the majority of participants include each other’s contribution in extensions to the database. As such, no minority of participants can modify the database and corrupt its data, introduce illegal modifications, or stop its maintenance. The most well known applications of Blockchain are cryptocurrencies, like Bitcoin.

2.3 Blockchain Technology History

Researchers coined the term Blockchain in 1991. The main goal of using Blockchain was to create a tool to timestamp digital documents [5] to ensure that no one could edit or change the documents. In 2008, under the name of Satoshi Nakamoto an author posted online an article titled, "A Peer-to-Peer Electronic Cash System," the writer discusses a digital currency known as Bitcoin which is transferred among people via a trusted networks [19].

2.3.1 Bitcoin

Bitcoin is the first well know application for Blockchain technology; the simple description of Bitcoin is a decentralized digital currency sent from user to user without any intermediaries or central banks, on a peer-to-peer network. Bitcoin is also know as a global payment network [5]. To get started with Bitcoin, a new user does not need to be computer savvy. According to [11], [23] the following steps explain the mechanism of creating a Bitcoin wallet and all the processes involved: first, users create a wallet on their devices and share the generated address with others. Second, all the transactions are hashed for the Blockchain, and users have a private key as a proof signature to ensure that they generated their transactions; the signature prevents any alterations on the transactions. Thirdly, all transactions are broadcast to the network and take 10-20 minutes to process. The mining side verifies and confirms transactions based on strict cryptographic rules [19].

2.3.2 Ethereum

In early 2014, Ethereum was conceived by Vitalik Buterin as a second generation of Blockchain technology. Ethereum is an open-source computing platform based on Blockchain, Smart contract and global computing system [8].

2.3.3 Smart Contract

A smart contract is a software program that is run on top of the Blockchain. It contains a set of rules which are agreed upon by the involved parties (miners), specifying how they should interact with each other and the chain on certain conditions. The code will be executed by miners when a particular event occurs [18].

2.4 Blockchain Structures Fall into Three Categories

Blockchain technology is divided into three major categories: Public, private, and hybrid Blockchain [30].

2.4.1 Public Blockchain

In public Blockchains, the transactions and records are visible to everyone on the network, and each node may take a step to confirm the consensus process. More time is needed to broadcast transactions because public Blockchains are decentralized and

contain a large number of nodes on the network. Once the transactions are stored on the network, there is no possible way to make any change.

2.4.2 Private Blockchain

With private Blockchains, the transactions and records are visible for the chosen node on the network. This visibility depends on the organization, and only the selected node can confirm the transactions. The centralized network reduces the time of the consensus process.

2.4.3 Hybrid Blockchain

With this type of Blockchain the transactions are visible for certain nodes or public for all the nodes on the network. Depending on the organization's choice, the Blockchain can be partially centralized.

2.5 Blockchain Technology Features

Six main features distinguish Blockchain technology from other technologies. According to [30] was explained these features are decentralization, persistency, audit-ability, anonymity, trustability and immutability. Each one of these features is explained as follows:

2.5.1 Decentralization

In the decentralized model, the transactions on the peer-to-peer network can be checked by each node on the Blockchain network without needing a third party. In contrast to the centralized model, the transactions must be checked by a trusted agency.

2.5.2 Persistency

Once the transactions are verified and disseminated by miners through distributed nodes on the network, any change in the Blockchain will easily be discovered. Editing or modifying the blocks is impossible.

2.5.3 Audit-ability

Because of this feature, users can check and track all the transactions on the Blockchain in a distributed environment. Even the oldest data recorded in Blockchain can be accessed.

2.5.4 Anonymity

All users on the Blockchain network can easily interact with their generated addresses, without knowing the user's real identities. Blockchain cannot guarantee to keep information private due to some intrinsic constraints.

2.5.5 Trustable

Among the users on the Blockchain peer-to-peer network, the data transfer is done in complete transparency. The stakeholders can transfer their data without any doubt about the extent of the other party's credibility.

2.5.6 Immutability

All transactions stored on the Blockchain system are immutable' because each block has a unique hash key linking to the previous block and the next block. As a result, any changes that occur to these transactions can be detected by the validation algorithm. The Only way to allow changing the records is a 51% attack (where the majority computation power coludes).

2.6 How Does the Blockchain Technology Works

The foundation of Blockchain is a list of blocks; a block contains the data, the hash of the block, and the hash of the previous block. The first block is a special block called the genesis block and it does not hold the hash of any previous block (see the Figures 2.1, 2.2, 2.3) [4]. If changes would happen on any block, all the following hashes would have to change. It is considered computationally impossible for someone to find two different blocks with identical hash [?]. To add a new block to the chain, a Proof of Work (POW) mechanism is used to verify and validate the block. The goal of using the POW is to fairly break ties concerning of who is allowed the creation of blocks,

in a decentralized way. The benefit of using the hash function and POW is visible in the security of the Blockchain [24]. See the figures below [4].

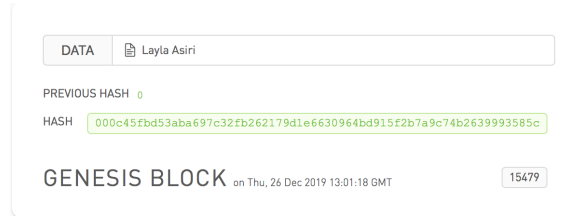


Figure 2.1: Genesis Block

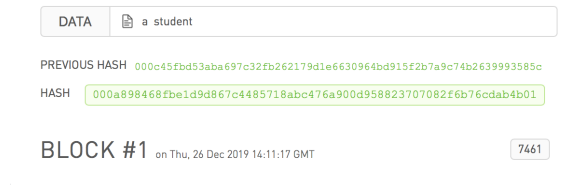


Figure 2.2: Second Block



Figure 2.3: Third Block

Chapter 3

Related Work

This research is focused on managing academic records, certificates, and diplomas. Researchers have assessed the value of keeping them in a system forever with a high level of security to enhance and develop the education environment. Several previous research studies and reviews provide proposals and implementations using Blockchain technology for management of certificates. Efforts were led to assist students and academic staff on understanding the value to students.

In 2018, Palma et.al. [21] described a prototype designed for integration of Blockchain technology with the Brazilian education system. The researchers propose storing the student's academic records in Blockchain by using smart contracts once students finish their required classes. The implementation of their proposal provides an interface between users based on three smart contracts: Authority, Curriculum, and Diploma. Additionally, the prototype for this study runs on the public Ethereum Blockchain and smart contracts are written in the Solidity language. The

researchers suggest for future studies to include all the academic records for students starting from elementary until graduate school. Authors claim that this prototype system was the first to issue diploma certificates using the Blockchain technology.

In 2018 Turkanovi and his colleagues proposed EduCTX [28] which is a global higher education credit Blockchain platform proposed in 2018, that focused on issuing and verifying diplomas. The difference between this study and the previous one is that their proposal provides each student an EduCTX Blockchain wallet for holding their academic records. This student wallet helps them gain access to their credit history. Additionally, they allow Higher Education Institutions (HEIs) to join the EduCTX network. They built their platform on top of the Ark Blockchain platforms, and their claimed future plan was to extend the work to be based on smart contracts.

In 2018, the researchers of the University of Zurich provided a proposal to verify diplomas based on a system called UZHBC [11]. The solution focused on reducing the drawbacks of paper diplomas and on avoiding the risk of fake certificates. Their approach is different from prior studies because they started by formalizing seven UZH requirements obtained from interviews with stakeholders. The interface of their system displays a window for users, and the architecture design is based on two functions. The first is the front-end; which takes a PDF document from the user, and the second function is the back-end; which takes the document and processes it. The hash of the material is packaged with a smart contract function and deployed on the Ethereum Blockchain.

In 2017, Matthew and his colleagues [14] suggested a potential use for Blockchain technology in libraries. Their idea is to provide secure scientific studies in libraries by linking the scientific documents with Blockchain. The documents are converted to a hashed document, and then a private Bitcoin key is created for that document to detect any changes. If the document has been edited or changed, the hash code changes. Users can verify changes fast. Another use for Blockchain technology in libraries is a tool to manage and reduce duplicate sources from the library. The Blockchain creates one unique record; anyone can access the records, but they cannot change them.

In 2019, Mahmood A. Rashid and his colleagues introduced a system called TEduchain, based on a public Blockchain platform. This platform establishes a contract between students and their sponsors and helps to collect and manage funds for students [22]. The author platform was designed to help students manage financial obstacles for completing their education. To handle this operation through the Blockchain network, TEduchain presents a practical dashboard to interact quickly between entities; which are students, fundraisers, and sponsors.

In 2018, Kolvenbach and his colleagues introduced [15], stopping the issuance of the paper certificates and fast verification are the primary goals of their work. Their work was based on the Ethereum Blockchain and smart contracts. They linked the certificates with the fingerprints in their system and stored them using the InterPlanetary File System protocol.

In 2018, Franzoni and her colleagues [10], introduced a platform called @prenda on the Ethereum Blockchain, implemented for a government. The primary function is to store teachers' certificates for having participated in teacher training in Mexico. In this system a smart contract is created which includes a wallet for each teacher's basic data. In addition, The courses' important information is stored in a smart contract and uploaded to the Blockchain. In their experiment 1,518 teachers in elementary school participated and stored their certificates in the Blockchain platform for teacher training in Mexico, from six states [10].

In 2018, Zhong and his colleagues [31] were conducted a study on adopting Blockchain technology to enhance the e-learning system by making a simulation for the word-learning community. This system was tested and evaluated based on the ISO quality model and Interplanetary File System. Data in this system is linked by Blockchain. Each learner has a unique address in this network, a smart contract is used to keep and save the users completed tasks. When the learner completes tasks, digital currency is offered. The participation among the users is high because of the extra payment for the first rank.

In 2019, [20] Palanivel and his colleagues presented a structure named proof of education transcript system (PETS) based on Blockchain technology for learning solutions. The solution is built on a distributed P2P network, and the smart contract is used to store and share the learning resources globally. The goal of this structure is to serve students by allowing them to choose their courses from the organizations or

institutions that they want. When the students choose the course they can pay the fee through the public ledger. After the students complete their courses by doing all assessments and tests, a miner verifies their final records and issues their certificates. The student's or learner's sensitive information is stored in a private Blockchain.

3.1 Applications and Platforms BC

Some applications and platforms are launched to store the academic records, certificates and diplomas

OpenCerts [7] is a platform based on Ethereum Blockchain and was created by the Government Technology Agency, Ministry of Education, Ngee Ann Polytechnic and Skills Future Singapore. Since 2019, OpenCerts started to issue students' academic records for 18 universities in Singapore. Their project depends on signing document hashes in the Blockchain without requiring any personal information from the students. The creator of OpenCerts ensures the maintenance of this platform for all students and educational institutes by easily verifying and sharing their certificate. Also, the platform offers an authentication window to check the certificates [3]. Advantages of the OpenCerts platform include: the security of the data, elimination of paper certificates and reduction the cost for student.

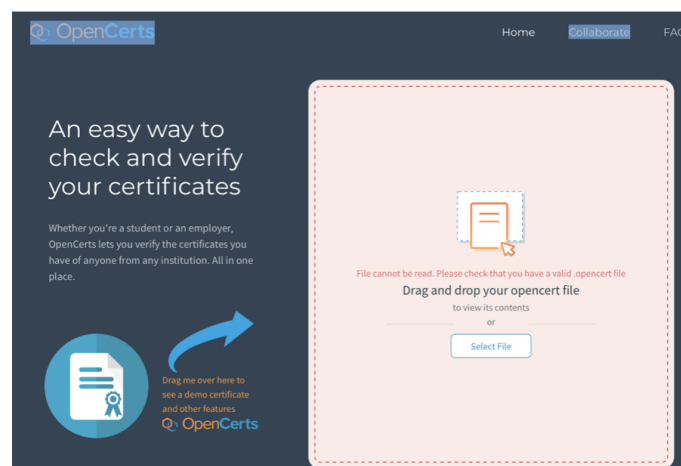


Figure 3.1: OpenCerts

TrustED [6] is a company located in Australia that has established a platform based on Blockchain technology for assisting to improve the educational environment. The TrustED's network is built to be a hybrid system between Hyperledger and Ethereum. The main goal for this platform is to simplify the process of verifying academic credentials. Some universities and schools in Australia, India, and Cyprus have already signed with this platform to manage and verify the student's academic records.

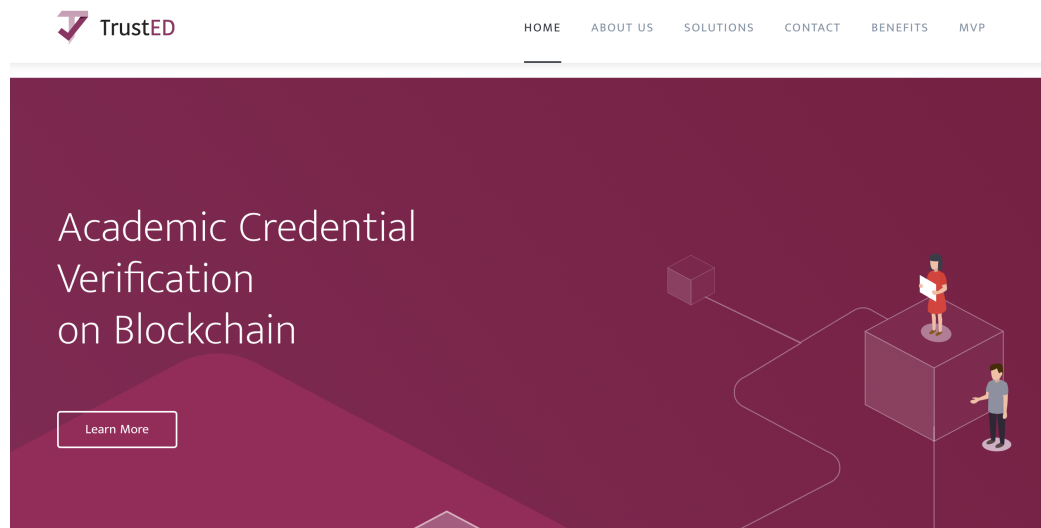


Figure 3.2: TrustED

UAEU Passport [2] is a digital application based on Blockchain technology, launched by United Arab Emirates University to enable the students and alumni to receive, manage their academic records via a digital wallet. The main goal of the UAEU Passport is to provide flexibility, ownership, and security for the student's credentials. It allows 75,000 students and alumni to access and share their academic records. This university-related sample application shows that the Blockchain technology is useful and efficient in the education process.

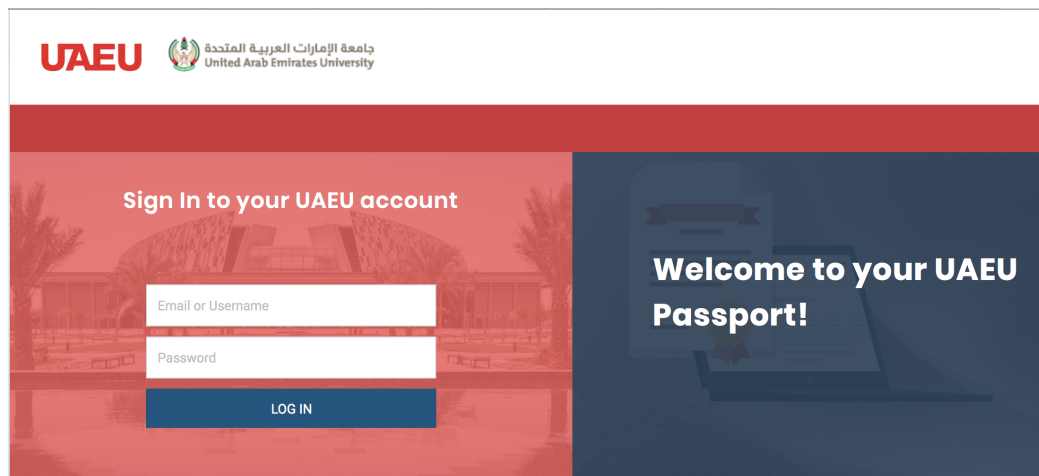


Figure 3.3: UAEU Passport

Chapter 4

Methodology

4.1 Introduction

This chapter introduces the study methodology for this research. There are two methods by which we chose to achieve the study goals, that are survey and interviews. Also, we explain how data will be collected and analyzed. The goal of this thesis is to evaluate the FIT students' opinions about adopting Blockchain technology to issue, manage, and verify certificates/diplomas. Additionally, we want to study the FIT registrar and HR to see their personal views and their level of understanding the Blockchain technology.

4.2 The Methods of Study

We conducted a survey and interviews to collect information about the participants' opinions and to evaluate what they knew about Blockchain technology. Also, we wanted to see what the participants' level of understanding Blockchain technology was.

4.2.1 Survey

We used an online survey tool, Qualtrics, for the survey and we requested the Research Involving Human Participants (IRB) approval before we sent the survey to the participants. Once we received IRB approval, the survey was sent as a link via social media and emails, and we used barcodes via contacting participants on the campus. We distributed the questionnaires to the mailing list of the Florida Institute of Technology (FIT) graduate and undergraduate students. This survey showed the informed consent as the first part. After the participants agreed to participate in the survey, the questions were divided into two parts. The first part was general questions about the problems that the participants may have faced with their certificates/diplomas after they graduated. The second part was about the participants' level of understanding Blockchain technology and their opinions about uses of Blockchain technology to issue and to manage their certificates/diplomas. From this survey, we figured out the problems that students might face after graduating with their certificates/diplomas. We asked the participants questions to figure out if they had any bad experiences

with losing or damaging their certificates/diplomas. Additionally, we figured out the percentage of the participants who would have liked to have had an electronic version for their certificates/diplomas.

4.2.2 Interviews

We performed two interviews: one was with the registrar and the second with HR, and the questions were the open-response type. Each interview took from 15 to 20 minutes, and the audio-recorder was used to get direct feedback from the participants. The interviews aimed to see how FIT currently issues certificates/diplomas and what procedures FIT takes to verify the employees' certificates/diplomas. Also, we evaluated their opinions about the adoption of Blockchain technology.

4.3 Tests Used in the Study

For the survey, we used two tests to analyze the data.

4.3.1 Descriptive Statistics

Descriptive statistics analysis was used to explain briefly the basic features of the data study. Descriptive statistics is a way that helps to organize and summarize data [13].

4.3.2 Chi-Square

Chi-square is a tool used to analyze group differences to spot there is a dependent variable [17]. A Chi-square test is used in the study to analyze the relationship between the participants and their demographic data.

4.3.3 Sentiment Analysis

Sentiment analysis is a tool to describe the emotions, attitudes, and opinions, of the participants from written language [16]. The main goal of using this test was to identify the emotional mode behind the said words to evaluate the participants' opinions about the adoption of Blockchain technology.

4.4 Summary

This chapter describes the methodology for this study, how the data was collected, and which tests were used to analyze the research founding.

Chapter 5

Results of the Study

It is important to understand the participants opinions regarding adopting Blockchain technology to issue, manage, and verify academic records such as certificates and diplomas.

5.1 Survey

5.1.1 Participates

The study was designed to explore the problem cases related to paper certificates and diplomas after the students graduate. The survey contained a variety of reliable and valid scales. The survey was distributed to Florida Institute of Technology's students and 101 have accepted to participate in the study from all different ages, genders, education levels, nationalities, and majors. In detail, the demographics of the participants are shown in the table below.

Table 5.1: Demographic Information

Demographic Variables			
		Frequency	Percent
Gender	Female	43	42.6
	Male	58	57.4
Degree level	undergraduate	48	47.5
	graduate	52	51.5
Age	18-24 years old	50	49.5
	25-34 years old	34	33.7
	35-44 years old	9	8.9
	45 older	8	7.9
Nationality	American	27	26.7
	Chinese	3	3.0
	Egyptian	3	3.0
	Indian	9	8.9
	Saudi	39	38.6
	Omani	15	14.9
	Emirati	4	4.0
	Zimbabwean	1	1.0
Majors	Aerospace Engineering	3	3.0
	Aviation	3	3.0
	Aviation Management	7	6.9
	Biomedical Engineering	6	5.9
	Biotechnology	5	5.0
	Chemistry	4	4.0
	Computer Engineering	6	5.9
	Computer Science	17	16.8
	Cybersecurity	11	10.9
	Dispatcher	2	2.0
	Electrical Engineering	3	3.0
	Information Systems	10	9.9
	Mathematics	5	5.0
	Mechanical Engineering	8	7.9
	Psychology	11	10.9

5.1.2 Study of Five Paper Drawbacks

We studied five cases that the students might face after they graduate, which are: loss, damage, late issuing, duplication, and when someone requested to keep the certificate.

Descriptive statistics were used to analyze participant's responses to the surveys regarding their certificates and diplomas: The results demonstrated that 23.8% of participants reported yes, while 76.2% reported no for losing their diploma. As shown in the table 5.2, the mean is 1.81 and Standard deviation is 0.428.

Table 5.2: Lost Certificates

Lost Certificates/Diplomas Case		
	Frequency	percent
Yes	24	23.8
NO	77	76.2
Mean 1.81 Median 2.00 Mode 2 Std .Deviation .428		

The results demonstrated that 18.8% of the participants answered yes that their paper certificates/diplomas were damaged, while the majority(81.2%), answered no that their paper certificates/diplomas were not damaged. The table 5.3 shows that the mean is 1.65 and Standard deviation 0.478.

Table 5.3: Damage Certificates

Damage Certificates/Diplomas Case		
	Frequency	percent
Yes	19	18.8
NO	82	81.2
Mean 1.65 Median 2.00 Mode 2 Std .Deviation .478		

Regarding if participants ever experienced someone requesting to keep their diploma, 29.7% of the participants answered yes, while the majority (70.3%) reported that they had never been asked to leave their certificates/diplomas by anyone. The table 5.4 shows the mean was 1.71 and Std.deviation 0.459. for this case.

Table 5.4: Someone Keep Certificates

Someone Request to keep Participant's Original Certificates/Diplomas Case		
	Frequency	percent
Yes	30	29.7
NO	71	70.3
Mean 1.71 Median 2.00 Mode 2 Std .Deviation .459		

Regarding issues with late issuing of certificates/diplomas, 34.7% of the participants reported experiencing problems with issuing their certificates/diplomas, while 65.3% reported not experiencing problems with issuing their certificates/diplomas. The table 5.5 shows the mean was 1.65 and Std.deviation 0.478.

Table 5.5: Late Issuing Certificates

Late Issuing Certificates Case		
	Frequency	percent
Yes	35	34.7
NO	66	65.3
Mean 1.65 Median 2.00 Mode 2 Std .Deviation .478		

Regarding problems associated with obtaining a duplicate certificates/diplomas if the original copy was lost, 29.7% of the participants reported that they experienced problems with obtaining certificates/diplomas issue, while 70.3% reported that they did not experience problems with obtaining certificates/diplomas issue. The table 5.6 shows the mean 1.70 and Standard deviation 0.488.

Table 5.6: Problem with Duplicate Certificate

Problem with Obtaining Duplicate Certificates/Diplomas Case		
	Frequency	percent
Yes	30	29.7
NO	71	70.3
Mean 1.71 Median 2.00 Mode 2 Std .Deviation .488		

Summary

In all five cases, we found out that the students have problems with their certificates/diplomas when they are based on a paper in the sample that we took from Florida Institutes of Technology. The result was up to 15% of the participants in each case were answered negatively.

5.1.3 Where Most Participants Keep their Certificate/Diplomas

First, participants were asked how many paper certificates/diplomas that they have earned. Results show that the majority of participants (48.5%) have one paper certificate/diploma, 21.8% of participants reported having two paper certificates/diplomas, and 29.7% of participants reported having many paper certificates/diplomas. Then, participants were asked where they usually keep their paper certificates/diplomas; the majority (74%) reported that they kept their paper certificates/diplomas at home, 18% of participants at other places, and 9% at the bank. These results are shown in the pie chart figure 5.1.

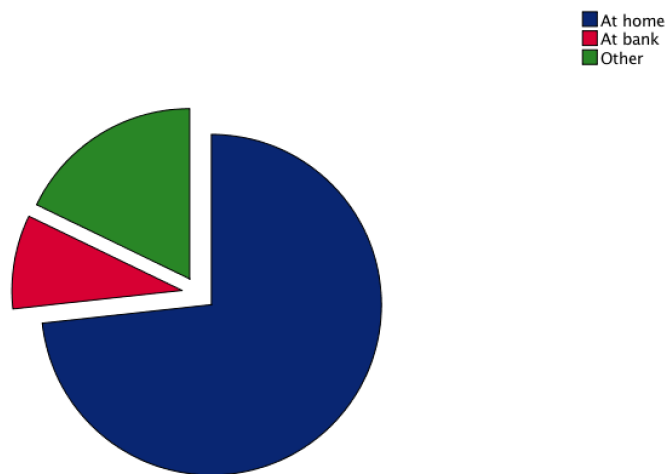


Figure 5.1: Keeping Certificates/Diplomas in

5.1.4 Electronic or Paper Certificates/Diplomas

Participants were asked two questions to determine preferences for their certificates/diplomas; do you prefer to have an electronic certificates/diplomas or paper certificates/diplomas? The study found that the percentage of participants who prefer an electronic certificate/diploma was 14%, while 12% prefer paper certificates. Most of the participants (75%) chose both types, electronic and paper certificates and diplomas. The mean for this question was 2.60, mode 3, and Std.deviation 0.722. Figure 5.2.

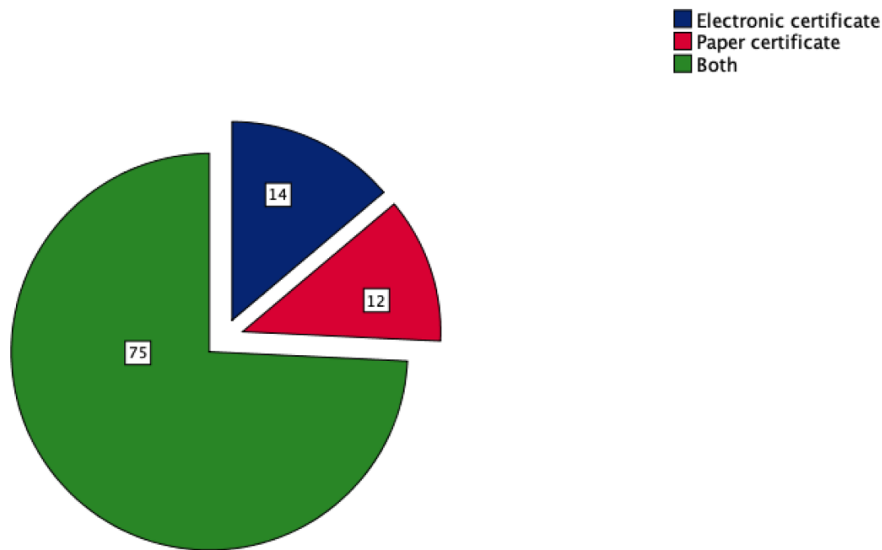


Figure 5.2: Electronic or Paper Certificates/Diplomas

5.1.5 Using Digital Currencies

As previously noted, Blockchain technology is the technique used for digital currencies. Thus, participants were asked a question to determine their usage of Blockchain technology; have you ever used digital currencies such as Bitcoin, Ethereum? The results show 17% of the participants answered yes, while 82% participants answered no, and 1% did not answer the question. For participants who answered yes, two additional questions were asked. First, was the use of Blockchain easier than the use of the traditional way of transferring money? Descriptive analysis was used to analyze the data, twelve participants answered yes, while six participants answered no. See the Figure 5.3.

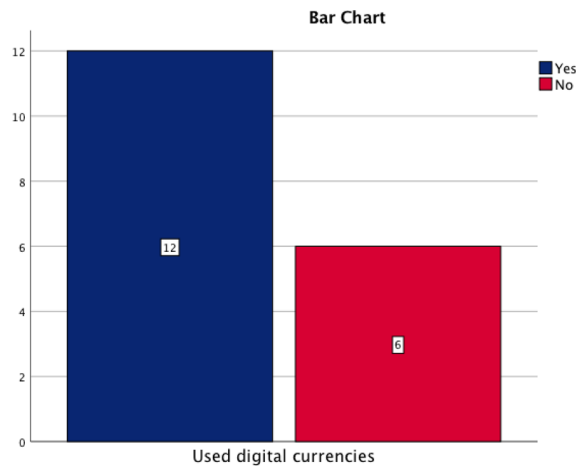


Figure 5.3: Using Digital Currencies 1

Second, would you use Blockchain technology to get your document instead of a paper document? Descriptive analysis was used to analyze the data. Eleven participants answered yes, while seven participants answered no. See the figure 5.4.

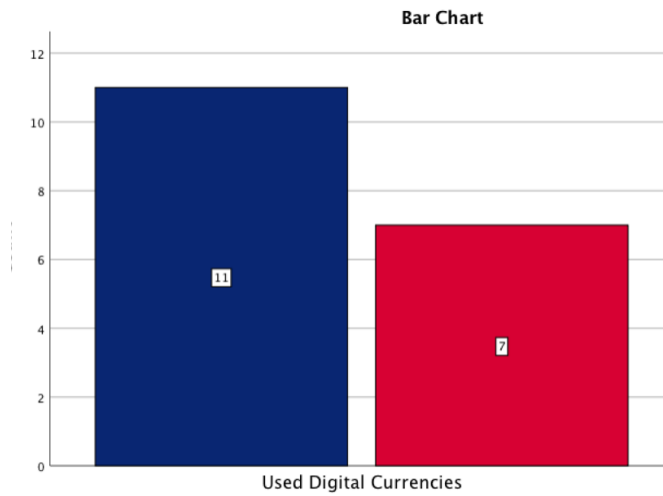


Figure 5.4: Using Digital Currencies 2

Summary

Seventeen percent of the participants used different kinds of digital currencies and 10% of them said transferring digital money via Blockchain technology was easier than another traditional way of transferring money. Additionally, 10% of the participants agree that Blockchain technology is more effective for managing paper documents.

To understand users' perspectives of Blockchain technology, participants were asked, from a user perspective, do you have a basic understanding of the Blockchain technology? Additionally, gender was included to determine if there is a relationship between user perspectives and gender.

Level of understanding of Blockchain technology (Gender) A Chi-square test was used to determine if there was a relationship between participants' gender and their level of understanding of Blockchain technology. The frequency result showed that 22 males and 17 females understood Blockchain technology, while 21 males and 40 females did not understand Blockchain technology. The result of chi-square test showed that there is a statistically significant relationship was proven between level of understanding of Blockchain technology and participants' gender; the p-value of Chi-Square test(0.030) <0.05 . See the Figure 5.5

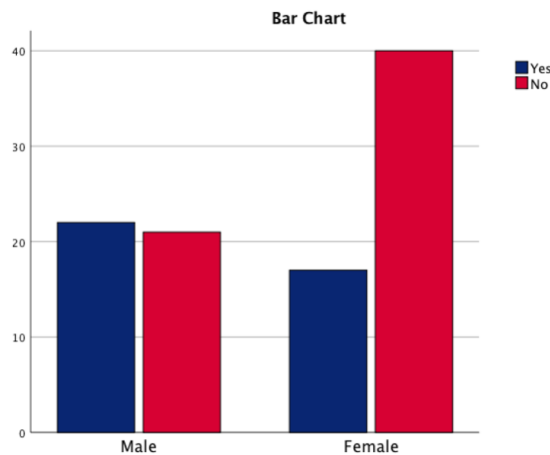


Figure 5.5: Level of Understanding of BC(Gender)

Level of Understanding of Blockchain Technology(Degree Level) The frequency result showed that nine undergraduate and 39 graduate participants understand Blockchain technology, while 29 undergraduate and 40 graduate participants do not understand Blockchain technology. The result of the chi-square test showed that there is a statistically significant relationship was proven between level of understanding of Blockchain technology and their degree level; the p-value of Chi-Square test $0.000 < 0.005$. 5.6

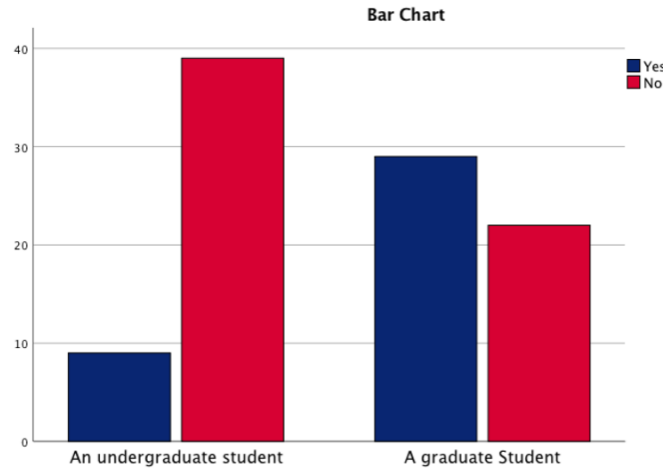


Figure 5.6: Level of Understanding of BC(Degree level)

Level of Understanding of Blockchain Technology (Age level) The frequency result shows that 10 participants from ages 18-24 indicated that they have some level of understanding about Blockchain technology, while 40 participants from the same age group indicated they do not have any level of understanding of Blockchain technology. Also, 17 participants from ages 25-34 reported some level of understanding of Blockchain technology, while 16 participants from the same age

group do not have any level of understanding of Blockchain technology. Furthermore, seven participants from ages 34-44 reported that they have some level of understanding about Blockchain technology, while four participants from the same age group do not understand Blockchain technology at all. Five participants from ages 45-older reported that they understand Blockchain technology, while four of them indicated that they have some level of understanding of Blockchain technology. Thus, a Chi-square test was used to determine if there was an relationship between participants' ages and their level of understanding of Blockchain technology. The result of Chi-square test shows that there is a statistically significant relationship was proven between knowledge of Blockchain technology and participants' age; the p-value of the Chi-Square test was $0.001 < 0.005$. Figure 5.7.

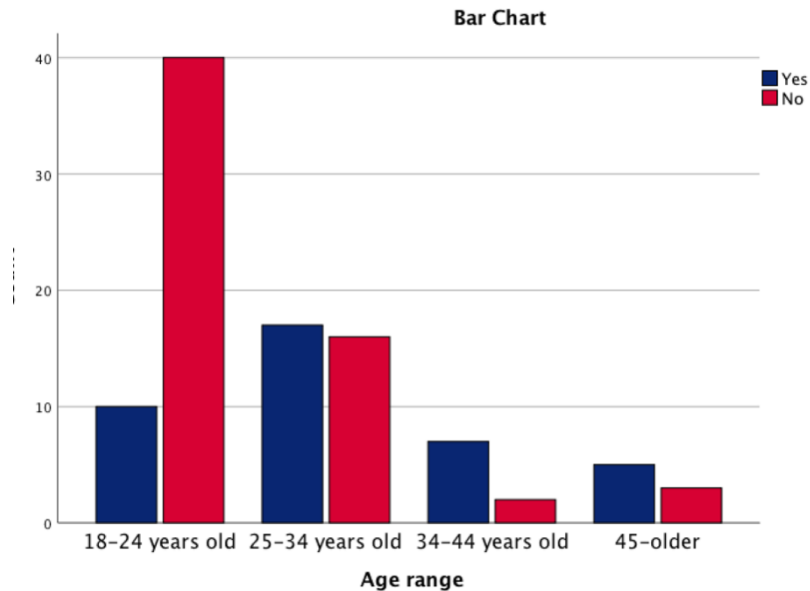


Figure 5.7: Level of Understanding of BC(Age level)

Level of understanding of Blockchain Technology (Major and Nationality)

To determine if there is a statistically significant relationship between level of understanding of Blockchain technology and the participants major and nationality a Chi-square test was used. Results of Chi-square test show that there is no statistically significant relationship was proven between level of understanding of Blockchain technology and the participants majors and nationality; the Chi-square shows p-values of $(0.180, 0.156) > (0.05)$. See the table 5.12

Table 5.7: The Chi-Square Test

Factor	The Chi-square test result
Major	0.180
Nationality	0.156

Summary

According to Chi-square test, there is a statistically significant relationship among participants' level of understanding of Blockchain technology and their demographic data, based on three-factors, age, gender, and degree level. However, there is no statistically significant relationship was proven between participants level of understanding of Blockchain technology and major and nationality.

To determine if participants know how Blockchain technology is used for managing diplomas and certificates, and the relationship between participants' demographics data and majors. The participants' were asked, do you know how Blockchain technology is used to manage certificates/diplomas? A Chi-square test was used to determine if there a relationship was proven between participants' demographics data (gender, nationality) and major, and if they know how Blockchain technology is used to manage certificates/ diplomas.

Gender

The frequency result shows that 17 males and 15 females know how Blockchain technology is used to issue and manage certificates/diplomas, while 26 males and 42 females do not have any idea about how Blockchain technology is used to issue and manage certificates/diplomas. The result of the Chi-square test shows that there is no statistically significant relationship was proven between participants' knowledge of Blockchain technology for managing certificates/diplomas and their gender; the p-value of the Chi-Square test $(0.161) > 0.05$. See the Figure 5.8.

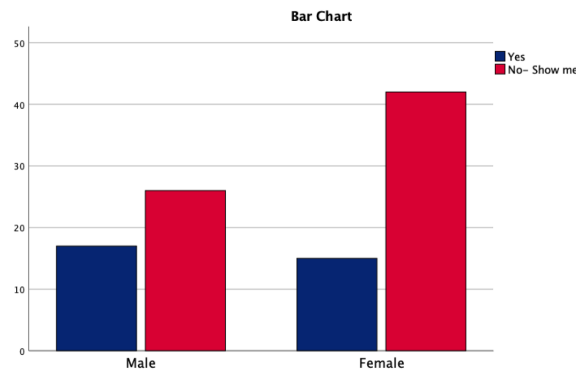


Figure 5.8: How to Manage Diplomas/Certificates (Gender)

Major

The frequency result shows that the majority of participants who know how Blockchain technology is used to manage certificates /diplomas were from the computer-related majors. Eight participants were from the Computer Science major, six participants from the Information Systems major and three participants from the Cybersecurity major reported they knew how Blockchain technology is used to manage certificates /diplomas. However, the result the Chi-square test shows that there is no statistically significant relationship was proven between participants' understanding about how Blockchain technology is used to manage certificates/diplomas and their major; Since the p-value of Chi-Square test (0.161)>0.05.,see the Figure 5.9.

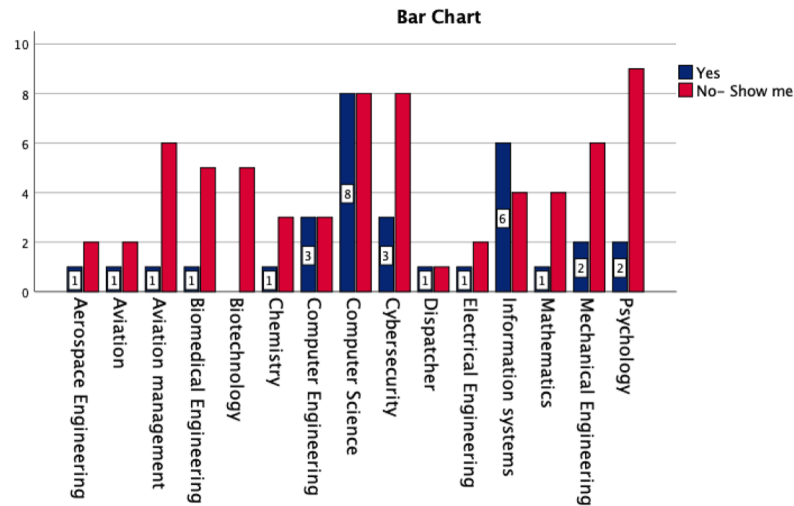


Figure 5.9: How to Manage Diplomas/Certificates (Major)

Nationality

The frequency result shows that the majority of participants (68) do not know how Blockchain technology is used to manage certificates /diploma. The result of the Chi-square test shows that there is no statistically significant relationship was proven between knowledge of how Blockchain technology is used to manage certificates/diplomas and their nationality; Since the p-value of Chi-Square test(0.374)>0.05,see the Figure 5.10

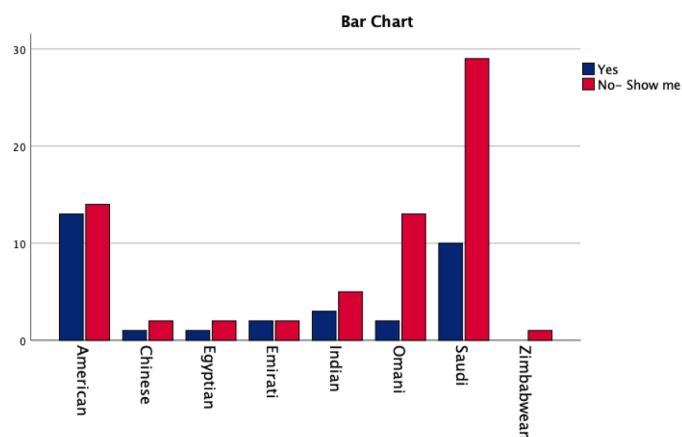


Figure 5.10: How to Manage Diplomas/Certificates (Nationality)

Summary

According to the Chi-square test, there is no statistically significant relationship between participants' demographic data and knowing how Blockchain technology is used to manage certificates /diplomas.

To understand the relationship between participants' opinions about Blockchain technology security for certificates/diplomas and their degree level and gender, participants were asked; do you feel that Blockchain technology can offer increased security for your certificates/diplomas in the future? A Chi-square test is used to determine if there is a relationship between participants gender and their perceptions of Blockchain technology security for their certificates/diplomas.

Gender

The frequency result shows that 32 males and 45 females have a positive perception of Blockchain technology security, while eleven males and eleven females reported negative perceptions of Blockchain technology security. The result of chi-square test shows that there is no statistically significant relationship was proven between perceptions of Blockchain technology security for certificates/diplomas and participants'gender ;Since p-value of Chi-Square test $(0.481) > 0.05$. See the Figure 5.11

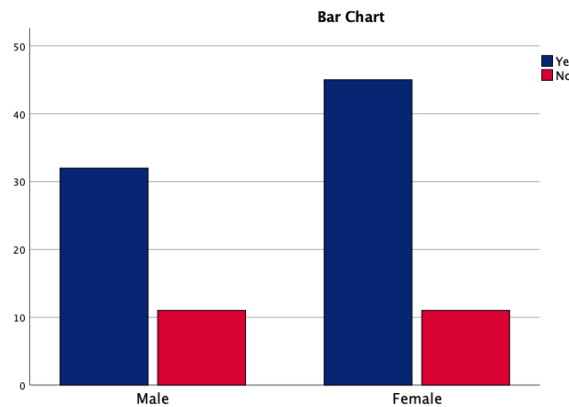


Figure 5.11: Blockchain Technology Security(Gender)

Degree Level

The frequency result shows that 35 males and 41 females have a positive perception of Blockchain technology security, while 12 males and ten females have a negative perception of Blockchain technology security. The result of chi-square test shows that there is no statistically significant relationship was proven between perceptions of Blockchain technology security for certificates/diplomas and their degree level; Since p-value of Chi-Square test was $(0.483) > 0.05$.

See the Figure 5.12

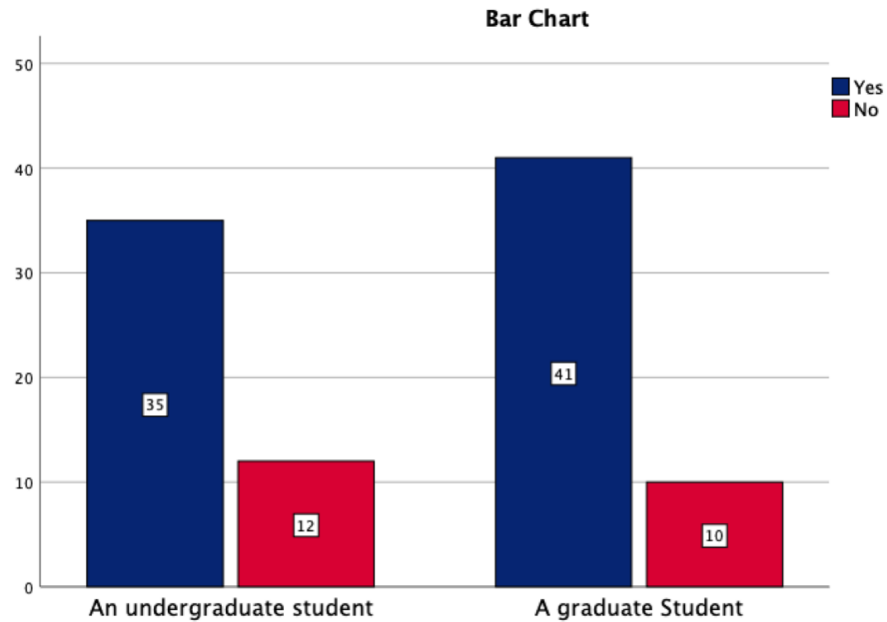


Figure 5.12: Blockchain Technology Security(Degree Level)

Summary

The results for p-value of Chi-Square test are $(0.060, 0.935, 0.627) < 0.05$. Therefore, there is no statistically significant relationship between perceptions of Blockchain technology security and participants' majors, nationalities, and age.

The Result Found from Survey

For these results, data collected from participants was analyzed using descriptive statistics and the Chi-square test. Problem cases were identified where participants might face issues with their paper certificates /diplomas after they graduate. Results show most participants do not have enough knowledge about Blockchain technology and do not know how it used to manage and issue their certificates/diplomas. However, according to the Chi-Square tests, around 80% of participants still want Blockchain technology to be used to manage and issue and secure their certificates/diplomas.

5.2 Interviews

For this study, interviews were conducted with Florida Institute of Technology (FIT) employees who are responsible for creating, managing and viewing students' degrees, and those who have the authority to hire the employees. The interview sample consisted of employees from the registrar and the human resources (HR) of FIT. Both departments were assigned codes, the registrar was assigned **P1** and HR **P2**.

5.2.1 Question 1

The first question was designed to identify the participants' level of understanding of Blockchain technology. For **P1** and **P1**, are you familiar with the concept of Blockchain technology?

The answers to this question as follows: **P1**: "I have some idea of Blockchain technology, my limited understanding is that it allows for code to be associated with a document to verify the document is authentic".

P2: "I am not familiar with Blockchain technology".

The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral. The result :

P1: Neutral-83%.

P2: Negative-74%.

5.2.2 Question 2

The following question administered to P1, how does Florida Institutes of Technology currently issue and manage students' academic records and certificates/diplomas?

P1: "We used to print the certificates and diplomas for the student since 2006, now we send the records in excel to a particular company to issue them for students". The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result :

P1:Neutral-61%

5.2.3 Question 3

The following question administered to both P1 and P2, do you expect that storing academic records on Blockchain technology will be more technically challenging for staff?

The answers to this question as follows:

P1: "I know many universities store diplomas through Blockchain technology, so I do not think it is a real challenge".

P2: "Since I am unaware of how we currently store academic records, I am not sure if Blockchain technology would be advantageous or not". The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result :

P1: Positive-98%.

P2: Negative-59%.

5.2.4 Question 4

The following question administered to P1, do you think the adoption of Blockchain technology might help students to manage their educational records more safely and more easily? The answer to this question as follows:

P1: "I think Blockchain technology would assist students in verifying their diplomas, they would be able to send the information to employees and/or degree verification's for international governments". The result classified responses by using the sentiment

analysis method and the categories included negative, positive, neutral The result :

P1: positive-98%.

5.2.5 Question 5

The following question administered to **P1** and **P2**, do you expect that applying Blockchain technology will raise additional security risks? If yes, why? The answer to this question as follows:

P1: “I think Blockchain for diplomas would cause little risk since the diploma is a formality, block chaining the transcript could pose a bigger threat since they are sought after to be forged. Forged transcripts cause many issues for universities”. **P2:**

“ N/A to what HR does”. The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result :

P1: Negative - 85.4%

P2: Neutral- 82%

5.2.6 Question 6

The following question administered to **P1** what do you think about the advantages of using Blockchain technology for certificates/diplomas? The answer to this question as follows:

P1: “I think Blockchain technology would assist students and possibly the university in the apostille and international governments confirming the authenticity of

diplomas. However, the governments would need to accept the document to become useful”. The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result is:

P1: Positive-54.1%

5.2.7 Question 7

The following question administered to **P1**, do you think Blockchain technology can reduce the student financial cost of managing the student records? The answer to this question as follows:

P1: Students’ records consist of more than just their transcript and diploma, so there will always be cost for storing student records. The result classified by using the sentiment analysis method to three different ways: Negative, Positive, Neutral.

The result is:

P1: Neutral - 50.4%

5.2.8 Question 8

The following question administered to **P1**, do you think Blockchain technology can be less time-consuming for communicating degrees for students? The answer to this question as follows:

P1: “I believe the Blockchain technology can assist in the security of student records, it will allow students access to their records with little interference”.

The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result is:

P1: Positive-63%.

5.2.9 Question 9

The following question administered to **P1**, some universities have taken the step of adopting Blockchain technology. Would you support a similar transition for your Organization? The answer to this question as follows:

P1:” Yes, why not”. The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result is:

P1: Positive-52%.

5.2.10 Question 10

The following question administered to **P2**,what is the verification process that HR does to verify an employee’s degree or certificate? The answer to this question as follows:

P2: “Florida Tech HR does not have a system or verification process to verify degrees. We require new hires/employees to send their official transcripts from the University/College in which they attended directly to the Office of Human Resources. Once received they are filed in their personnel folder”.

The result classified responses by using the sentiment analysis method and the categories included negative, positive, neutral The result is:

P2: Negative-84%.

5.2.11 The Results Found from Interviews

In the previous questions, we attempted to understand better what the registrar and HR at FIT know about Blockchain technology and their personal opinions about adopting the technology to issue, manage, and verify certificates/diplomas. We found that the registration department answered all the questions, and most of their answers were positive, which means that they supported the idea of adopting Blockchain technology to issue and manage the certificates/diplomas. Otherwise, the HR department did not answer most of the questions, and the others were answered negatively. We saw that HR had concerns about applying the new technology.

Chapter 6

Conclusion

Prior researchers have already proposed Blockchain technology to assist and benefit the educational environment. Besides the problems associated with falsifying paper certificates and diplomas and the sites that sell them, there are other problems that students may experience after graduation due to paper certificates. This research aims to identify some of the paper certificate related problems and evaluate the promise of the alternative Blockchain-related solutions for paper certificates and diplomas. The Blockchain technology is useful for preventing forgery when issuing, managing, and authenticating certificates and diplomas. The study aims to gather the Florida Tech student's insights about the adoption of Blockchain technology to issue, manage and verify certificates and diplomas. Assessing and understanding the views of people who are responsible for creating and managing students' academic records about Blockchain technology is necessary to determine the need and desire for Blockchain Technology.

6.1 Result

The study confirms that paper certificates and diplomas are an important problem for students that have graduated; these certificates and diplomas might be lost, damaged, and so on. Approximately 80% of FIT students who participated in this study reported acceptance for adoption Blockchain technology to issue certificates and diplomas, even if they are not very knowledgeable about this new technology. The results for the p-value of the Chi-Square test were less than (0.05). Therefore, there is a statistically significant relationship was proven between participants' self-reported level of understanding of Blockchain technology and their demographic data, based on three-factors, age, gender, and degree level. However, no statistically significant relationship was proven between participants' level of understanding of Blockchain technology and major or nationality. The results for the p-value of the Chi-Square test were greater than (0.05). Therefore, no statistically significant relationship was proven between perceptions of Blockchain technology security and participants' demographic data. Also, The results for the p-value of the Chi-Square test were greater than (0.05). Therefore, no statistically significant relationship was proven between participants' demographic data and self-reported knowledge of how Blockchain technology is used to manage certificates/diplomas. Moreover, the interviews conducted with the registrar and HR at FIT illustrate that the registrar supported the idea of adopting Blockchain technology to issue and manage the certificates and diplomas; while the HR reported concerns about applying new technology. However, larger pop-

ulations of participants are needed, as some results are found to not be statistically significant given the available samples.

Appendix A

Institutional Review Board (IRB)



**Notice of Exempt Review Status
Certificate of Clearance for Human Participants Research**

Principal Investigator: Layla Asiri
Date: December 31, 2019
IRB Number: 19-186
Study Title: The Tradeoffs of Applying the Blockchain Technology in Education

Your research protocol was reviewed and approved by the IRB Chairperson. Per federal regulations, 45 CFR 46.101, your study has been determined to be minimal risk for human subjects and exempt from 45 CFR46 federal regulations. The Exempt determination is valid indefinitely. Substantive changes to the approved exempt research must be requested and approved prior to their initiation. Investigators may request proposed changes by submitting a Revision Request form found on the IRB website.

Acceptance of this study is based on your agreement to abide by the policies and procedures of Florida Institute of Technology's Human Research Protection Program (<http://web2.fit.edu/crm/irb/>) and does not replace any other approvals that may be required.

All data, which may include signed consent form documents, must be retained in a secure location for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Access to data is limited to authorized individuals listed as key study personnel.

The category for which exempt status has been determined for this protocol is as follows:

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior so long as confidentiality is maintained.
 - a. Information is recorded in such a manner that the subject cannot be identified, directly or through identifiers linked to the participant and/or
 - b. Subject's responses, if know outside the research would not reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing, employability, or reputation.

Appendix B

Survey

The Informed Consent Form

First thank you for being able to open my survey

You are being asked to take part in a research study .Before you decide to participate in this study ,it is important that you understand why the research is being done and what it will involve. Please read the following information carefully .

purpose of study :

The purpose of this study is to evaluate the challenges of using Blockchain technology for issuing and verifying academic records, certificates, and diplomas for students. Blockchain technology can be hard to use and present additional costs but may suggest additional security. However, in the long term, the persistence properties are not yet known based on experience, and this can generate limits in user trust. We want to evaluate how alternative technologies in use mitigate these concerns and whether humans are more positively reacting to some of the approaches.

The survey content :

The procedure involves filling an online survey that will take approximately 15 minutes. Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. The survey questions belonging to certificate /diplomas and the way to being more secure .

Contact :

If you have further question please be free to ask me about it .
Email :lasiri2017@fit.edu

Electronic consent :

Please select your choice below according to these point
You have read the above information
You voluntarily agree to participate.

<>Agree

<>Disagree

Demographic Questions :

Q1:What is your gender ?

Male

Female

Other

Q2: what is your age ?

18-24 years old

25-34 years old

34-44 years old

45-older

Q3: what is your country ?.....

Q4: What degree are you currently pursuing?

An undergraduate student

A graduate student

Q5: what is your major ?

Q6: How many certificates /diplomas do you have?

1) one

2) two

3) many

Q7: Do you have an electronic version of your certificate/diplomas?

1) Yes

2) No

Q8: Have you ever lost your certificate/diplomas?

1) Yes

2) No

Q9: Has your certificate /diploma ever been damaged?

1) Yes

2) No

Q10: If you have a paper certificate / diploma, where do you keep it?

1) At home

2) At bank

3) Other: _____

Q11: Do you think your certificate is secure?

1) Yes

2) No

3) Not sure

Q12: would you prefer to have an electronic certificate or certificate based on paper?

1) Electronic certificate

2) Paper certificate

3) Both

Q13: Has anyone ever asked to keep your original diploma with them, like :work?

1) Yes

2) No

Q14: Did you ever leave your original diploma with a person who asked for it?

1) Yes

2) No

Q15: Have you experienced issues with late issuing of certificate/ diploma ?

1) Yes

2) No

Q16: Have you faced a problem with obtaining a duplicate certificate /diploma in case you lost your original?

1) Yes

2) No

Q17: Are you familiar with degree mills (companies or organization that sell illegitimate academic degrees)?

- 1)Yes
- 2)No

Q18: Do you have basic understanding of Blockchain technology ?

- 1)Yes
- 2)No

Q19:Have you ever heard of Digital Currencies so far?

- 1)Yes
- 2)No

Q20:Have you ever used Digital Currencies ("cryptocurrencies") such as bitcoin, ethereum?

- 1)Yes
- 2)No

Q21: Was the use of Blockchain technology easier than the use the traditional way of transfer money?

- 1)Yes
- 2)No

Q22:Would you continue using blockchain technology instead of paper document ?

- 1)Yes
- 2)No

Q23: Do you think that blockchain technology will benefit educational industry in the future ?

- 1)Yes
- 2)No
- 3)N/A

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