Beyond Bitcoin Cryptocurrency, Blockchain in Education

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Summary
Beyond its first and conventional use, blockchain is being implemented across various fields. Blockchain first implementation was Bitcoin in 2009 and after the wide acceptance of Bitcoin; technologies from multi-disciplinary are trying to implement blockchain professionally. One of the prominent Blockchain use cases is in the Education sector. In this study, we employed the well-known approach Technology Acceptance Model (TAM) for predicting acceptance of Blockchain implementation in education in the Kingdom of Saudi Arabia KSA. Our main goal is to measure the intended use and acceptance of blockchain in KSA higher education system. The study extends the TAM model and testing its validity as well as applicability in the higher education context to explain and predict students' behavioral intention. We proposed external independent variables and we set some hypotheses to confirm the study results.

Key words:
Blockchain, Bitcoin Cryptocurrency, Distributed Ledger, Technology Acceptance, Behavioral Intention, TAM Model, Blockchain in Education.

1. Introduction

The modern teaching institutes looking for new innovative technologies that appeal to the students and improve their teaching quality. Technologies that go beyond smart boards and remote learning to promote a higher level of personalized and Interactive learning, where instructors and learners can get access to study materials, share their projects and ideas, request materials, and ask for feedback [1]. To satisfy this requirement, many technologies have been evolved to improve the teaching-learning process. One can consider the using of smart devices (e.g., tablets and mobiles) that enable educators to access websites and applications to the using of Internet of Things IoT technology that facilitates the creation of the next-generation smart campus [2].

Smart applications usually need continues Internet connection, and having a secure connection and secure storage is no doubt. Since, there are notable increases in cyber threats which may results in catastrophic consequences. Here it appears the demand for alternative technological solutions [3, 4]. Blockchain is one of the most promising alternative new technologies within the field in recent years. Blockchain is not only an alternative supplement to the existing cybersecurity solutions, but also it is a new way of storing, retrieving and transferring data securely and transparency [5].

Blockchain was invented by Satoshi Nakamoto in 2009 as an online currency named Bitcoin [6]. It based on open distributed hash ledger between peer to peer nodes, the Bitcoin technology is decentralized alternative to traditional monetary, and it eventually turned into what so called technological revolution. Blockchain has been utilized in many different applications and not limited to monetary activities. For instance, it is employed in business, finance, production, import, export, industry and many others, to secure information storage, and improve information sharing and networking. With the help of this advanced technology, the gap in credentialing, efficient communication, and copyright protection is filled up. Moreover, the system processes will become faster, easier, and safer [7].

Our focus on this work will be on adoption of Blockchain technology in higher education, where there has been little efforts spends on this new technology in the higher education sector [8]. This work aims to develop a theoretical model that could be adopted among corporations of this technology. The research can form a basis for broader future studies on Blockchain technology in higher education.

Existing research on the adoption of Blockchain technology, such as the “Braving Bitcoin,” utilized the TAM model and expanded it to include factors for measuring electronic commerce [9]. However, in this research, we are looking to expand the TAM model with external factors that reflect the adoption intentions. Specifically, besides the original TAM belief constructs (e.g., perceived usefulness and perceived ease of use), a set of new external variables are added to our model (e.g., privacy, anxiety, and cost).

Our approach on this work is to test and of establish a theory model of Blockchain technology in higher education. And in order to collect the necessary data for testing the research model and determine the adoption intentions, a survey will be constructed specifically for this study and will be distributed to 385 randomly selected student respondents from different higher educational institutes. The collected data will be analyzed using the Structural Equation Model (SEM) based on the Partial

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Least Square (PLS) approach [10]. Such research is important to assist the decision-makers to be aware of the acceptance of Blockchain technology in education and understand the determinants of acceptance to minimize resistance or rejection by users.

The remaining paper is divided into five sections. Section 2 provides background material needed to understand the research problem and its significance. Section 3 provides a relevant literature review. The research's objectives and methodology are then specified in Section 4. The research hypotheses, along with the theoretical framework, are outlined in Section 5. The conclusion and future work are in Section 6.

2. Background Material

In this section, the primary concepts that we need to be familiar with are introduced. Firstly, the blockchain development is briefly described. Then, the blockchain applications in education are given. Finally, some of the potential issues of applying blockchain technology in education are discussed.

2.1 Blockchain Development

A blockchain is a type of electronic ledger, distributed database that forms a new way of documenting data on the internet [6]. The data recorded on a blockchain can take any form, transactions, identities, an agreement between two parties, or any data that store in blocks. Blocks are appended and linked together, forming a chain of blocks through a process called hashing. A hash function is a cryptographic algorithm that takes any arbitrary input size and produces an output of a fixed length size. The hash is produced by running the selected cryptographic hash algorithm on the blockchain content (i.e. block content) to generate the unique hash value of the block content, the hash should be easily produced for any arbitrary input, but it should very hard to retrieve back the input based on the output hash. Additionally, any changes in the original input data should result in extensive and uncorrelated changes to the output hash [11].

Blockchain is not controlled by anyone, and it is duplicated (distributed) in its entirety across participants/users. This has a great advantage as a user can view or edit the chain from anywhere if she has the right cryptography keys. Moreover, the blockchain is considered so trustworthy because the recorded data in blocks cannot be altered without having to modify all the blocks after it [11, 12].

Bitcoin cryptocurrency based on the concept of blockchain, where it is decentralized open ledger, peer-to-peer electronic cash system and strongly chained by chain of cryptographic blocks. Today, developers and researchers in various fields believe that applications of blockchain is not limited to cryptocurrencies, but it extends to cover most of the known traditional and nontraditional implantations as medicine, education, industry, fabrication, distribution and many others, now days variety sectors are looking for ways to integrate blockchain into their infrastructures.

2.2 Blockchain Applications in Education

Below are some applications that are being presented in the education sector [13,14]:

- Innovation learning platform: creating an ecosystem based on the Blockchain to connect academicians and learners. For instance, the Education Ecosystem platform is a notable project that allows learners to share their ideas and get access to study materials and feedback. The communications are based on the internal tokens earned when users make contributions and used to request materials or download books.
- Transcripts and Certificates: Blockchain technology can maintains the whole transcript attributes by storing the academic records in the distributed Blockchain repository. Diplomas, notes, and titles obtained are protected from being modified, tampered with, deleted or lost. Universities like Nicosia manages students' certificates using Blockchain technology, Massachusetts Institute of Technology issued certifications of the Media Lab on a Blockchain network. Moreover, these documents (Certifications and Records) can be delivered anytime, anywhere, through the Blockchain and allow users to get fast access to their records and share them with potential employers.
- Securing the archives: the Blockchain can handle different sorts of educational information with the user's unique Identification (ID). It can be applied in many creative ways beyond just diploma management. It facilitates broader applications on keeping track of the whole learning processes. The primary goal is to secure the stored information recorded in a chain. So, data cannot be altered manually since the advanced encryption measures protect it. This may also protect academic research rights or financial transactions from theft or plagiarism when a project is presented as a new one.

Behind the applications in the education sector, Blockchain is able to offer services in human resources, where recruiters have to verify information accuracy provided by the candidates for vacancies. This will significantly reduce the workload and the time spent by recruiters as well as facilitates other functions like automating agreements, payments, tuition or taxes.

Overall, Blockchain can solve problems related to information trust among stakeholders because of its nature of decentralization and immutability. It provides a trustworthy way and ensures authenticity because the information is published and maintained collectively. Blockchain ledger tracks everything the user has obtained. Employers can use this information to find the best match for a job. Users can also use the Blockchain ledger to store safely their qualifications and offered anytime. In a word, Blockchain decreases the risk of bias and maximizes the interests of both parties [14].

3. Technology Acceptance Model (TAM)

Davis [15] developed the Technology Acceptance Model (TAM) in 1986. The model measures how users accept and utilize technologies. The model has been validated through an empirical test by among others [16] and explains around 40 percent of the variance in the intention of actual usage.

In TAM, Davis introduced the concept of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). The PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [15]. And the PEOU explains "the attitude and intention of usage in the TAM model". Authors of [16] show that the TAM model and PU has been validated as a strong determinant of the intention of usage with a standard regression coefficient around 0.6.

Complementing PU and PEOU, TAM also includes external variables such as social influence. Davis explains these as "provide the bridge between the internal beliefs, attitudes, and intentions represented in TAM and the various individual differences, situational constraints and managerially controllable interventions impinging on behavior" [15]. In the literature, some examples of external variables could be user characteristics like level of education, age, and gender. Researchers in [17] have researched 70 different external variables that can explain partially usage intention.

Besides these factors, other factors have been adopted from well know theories; The Perceived Cost (PC) factor that is adopted from the Perceived Characteristics of Innovating (PCI) theory [18]. The Privacy Concerns (PCO) factor that is adopted from the Theory of Reasoned Action (TRA) [19], and finally, Computer anxiety (ANX), which is defined as an individual's apprehension or even fear when she/he is faced with the possibility of using computers [20].

4. Related Work

Davis et al. [15] developed a Technology Acceptance Model (TAM) for predicting users' acceptance of Information Technology (IT) by introducing a number of constructs like PU and PEOU. The model determines the user's behavioral intention and actual usage by fining the relationships among these constructs. These relationships have been validated empirically in many studies of user acceptance [21].

There are some studies investigated the adoption process [22, 23]. Most of them have looked at the influence of Blockchain and the cryptocurrency bitcoin for the financial aspects. For instance, the research [24] investigates the effect of effort expectancy and social influence. Results showed that there is no evidence that performance expectancy and facilitating positively affect the intention to use crowdfunding.

In contrast, the results of [25] showed a positive effect of performance expectancy, effort expectancy, and social influence on the intention to use a payment authentication system. However, the work in [26] showed that performance expectancy and effort expectancy positively influence the behavioral intention to adopt plastic money, while social influence and facilitating conditions do not significantly affect it.

The Cryptocurrencies and Bitcoin for electronic payments have also considered in the literature. Authors of [27] found that the most influential factor in the intention to use cryptocurrencies is the PU. They also found that social influence has no support for the direct effect on the intention to use cryptocurrencies and bitcoin. On the other hand, the work in [28] found that social influence and perceived behavioral control are significant.

It is important to mention here that more specific studies have considered academic and higher education in Saudi Arabia. The researchers of [29] studied the decision behavior of individuals toward the acceptance of e-learning in academic settings. The work of [30] extended the TAM model to study the lack of learning management systems (LMS) availability, prior experience, and job relevance.

Ultimately, one must note that there is a lack of studies related to external and organizational factors being utilized with the TAM. As seen from the above discussion, none of them has utilized the TAM model for determining the acceptance of Blockchain in the education sector in

the Kingdom of Saudi Arabia. This will motivate us to conduct such a study.

5. Research Objectives and Methodology

Our study helps decision-makers in Saudi Arabia understand and awareness of the adaptation of Blockchain in the education sector. The key point is to recognize the factors influence the behavior of the learners toward using such technology. Hence, this study concentrates on the factors affecting the acceptance of Blockchain for education from a conceptual viewpoint rather than a specific product or service. Thus, the takeaway of this research is a framework that suitably explains the acceptable behavior and provides the initial groundwork for potential future research.

To achieve the aforementioned objective, this study utilizes a reasoning procedure for hypotheses development and evaluation. It comprises four stages; building up the model, detailing testable hypotheses, gathering data, lastly, testing the hypotheses [31]. To collect the required data, a survey instrument will be developed to measure the perception of Saudi learners in using Blockchain technology for educational purposes. The survey instrument will be structured in two parts: Part 1 contains certain sociodemographic questions (respondent education level, gender, and income) and a basic question on Blockchain awareness that has been used as a screening question.

The screening question will be used in order to minimize the hypothetical response biases from those people who absolutely have no idea or prior knowledge about Blockchain. The screening question is, “Do you know what Blockchain technology is?” Response options will be “no idea,” “have an idea.” Respondents answering “no idea” will be filtered out from the remaining survey. For all other respondents, they will be moved on to part 2, which will contain open-ended questions. All the questionnaire items will be evaluated on a 5-point Likert scale (1. strongly disagree to 5. strongly agree).

In order to get a sufficient number of subjects to generalize our model, the survey should be distributed over 350 participants to collect data to test the research model. All the responses that pass the screening requirement will be considered for the final analysis. The collected data on this work will be statistically analyzed using Structural Equation Model (SEM), based on the Partial Least Square (PLS) approach. This approach should be able to determine and examine the overall model as one unit. It could additionally examine models with multiple independent factors, even if there are correlations between different unbiased factors. Furthermore, the goodness of the path coefficients to be examined, and the hypotheses’ testing to be executed by using a suitable approach based on the shape of the collected data [32].

6. The Theoretical Framework

Davis [15] developed the Technology Acceptance Model (TAM) in 1986. The model measures how users accept and utilize technologies. The model has been

6.1 Research Factors and Measurements

The TAM model will be adopted as the theoretical foundation of our research model. Besides the TAM factors (Behavioral Intention BI to Use and Perceived Usefulness PU), three additional factors (Technology Anxiety TA, Perceived Cost PC, and Perceived Privacy PP) are considered in this work. For each factor, a set of measurements are used to measure it. These factors and measurements will be utilized to design the study survey. Below is a list of these factors along with their measurements:

- Perceived Usefulness (PU), which will be measured using 6 items:
  - Accomplish tasks more quickly.
  - Improve my job performance.
  - Increase productivity.
  - Enhance effectiveness on the job.
  - Make the job easier.
  - Useful in the job.
- Behavioral Intention to Use (BI), which will be measured using 3 items:
  - Intend to use.
  - Predict to use.
  - Plan to use the services.
- Technology Anxiety (TA) with 4 items to measure:
  - Computers do not scare me at all.
  - Working with a computer makes me nervous.
  - Computers make me feel uncomfortable.
  - Computers make me feel uneasy.
- Perceived Cost (PC) with 3 items to measure:
  - Cost of technology.
  - Easily afford the services.
  - The burden to me the services.
- Perceived Privacy (PP) with 3 items to measure:
  - Others can use my personal information.
  - Others can steal personal information.
  - Concerned about standards used for protection.

6.2 Research Hypotheses

Having defined the required factors, it is important to build up relations with them in the research model, in which this should be possible by planning hypotheses. With respect to that, this work designs the hypotheses in a directional organization. In this configuration, the connection between two factors is illustrated with terms such as (positive, negative). Based on the discussion above, the following hypotheses are formulated:

H1: There is a positive relationship between PU and BI.
H2: There is a negative relationship between TA and BI.
H3: There is a positive relationship between PP and BI.
H4: There is a negative relationship between PC and BI.

7. Research Model

This work utilizes theories testing, which shows the idea of relationships. (Figure 1: the research model) depicts the proposed mode, which maps the research hypothesis and will be utilized to check the speculations and distinguish the relations amongst the tested components.

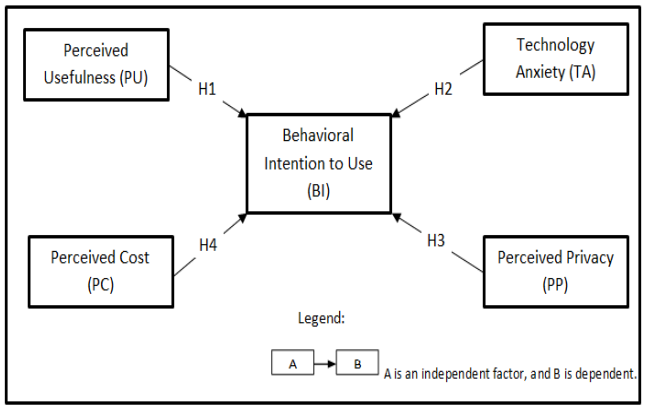

Fig. 1 The Research Model

8. Conclusion and Future Work

Even though the Blockchain technology has been successfully implemented into different disciplines, there's still doubt about the reliability of this technology. In fact, little is known or used in a real-world practicable context. Current knowledge is mainly based on the imagination of researchers and Blockchain aficionados trying to forecast socio-economic effects and application concepts. Therefore, in this study, we employed the well-known approach (TAM) for predicting acceptance of Blockchain in higher education. Our main aim is to measure the direct effect of a set of variables on the intended use rather than actual system use of Blockchain in the education sector in Saudi Arabia. The theoretical contribution can be observed in the extended TAM model and testing its validity as well as applicability in the higher education context to explain and predict students' behavioral intention. To do that, a set of variables were proposed as external independents variables, not as antecedents. As future work, we will carry on the data analysis for our model and investigate further variables in the area of acceptance

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