SOFTWARE AND INFORMATION ENGINEERING SESSION

STUDENT MOTIVATION TO LEARN ABOUT BLOCKCHAIN TECHNOLOGY

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Abstract:
In this paper, we explore factors contributing to student intrinsic and extrinsic motivation to learn about blockchain technology and cryptocurrencies. We surveyed N=84 university students on the abovementioned topics. First, we examine their familiarity with these new technologies, together with their habits concerning cybersecurity risks involved with owning cryptocurrencies. Then we further investigate their interest and motivation to learn about blockchain and cryptocurrency..

Keywords:
blockchain, cryptocurrency, student motivation.

INTRODUCTION

Blockchain technology is relatively young. Bitcoin, which is the world's first blockchain, is only eleven years old. However, this technology is advancing very fast, and billions and billions are invested every year in its further development. Recent happenings with Bitcoin price reaching as much as 20000 dollars in December of 2017 and then dropping back to 3100 have made this technology world known. Possibly for all the wrong reasons but still that whole publicity contributed to the further development of blockchain technology. In this paper, we surveyed N=84 university students to explore further three topics related to cryptocurrencies and blockchain technologies. Student acceptance of blockchain technology is the first topic we discuss. Every new technology goes through a cycle of acceptance. Blockchain technology is currently in the very early stages of the acceptance cycle; therefore, it is interesting to explore the extent of blockchain technology acceptance within the student population. The awareness of security risks of holding cryptocurrencies is the second topic. Knowledge of security risks that come with owning and using cryptocurrencies is also a relatively new topic, not fully explored yet. Students' motivation to learn about blockchain technologies is the third topic we explore in this research paper.

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1. LITERATURE REVIEW

Blockchain technology

As mentioned before, blockchain is very new technology. That said, the first paper published about blockchain is the bitcoin whitepaper [1] by Satoshi Nakamoto. In this now-famous paper, Nakamoto describes a novel system for cash transactions over the Internet. Based on a peer-to-peer network, this system allows transactions to be made without going through a financial institution. Instead of a bank, there is a decentralized network that creates tokens and processes transactions. This means that every node in the network can make transactions without asking for permission. For the first time in human history, there is an asset that cannot be confiscated by authorities. Only a person that is in possession of the private key associated with an unspent transaction can move the funds. This also means that a transaction can't be rolled back once it is included into blockchain which significantly raises the level of IT security awareness and education needed to securely use and store it. Bitcoin, the first cryptocurrency, is also open-source software that allows anyone with adequate programming knowledge to easily copy or modify its source code and make new Bitcoin-based cryptocurrencies. Besides derivatives of Bitcoin, there are also cryptocurrencies that were programmed from the ground up, but the vast majority of cryptocurrencies are Bitcoin derivatives.

These cryptocurrencies are collectively called altcoins. As their name implies, they offer an alternative to Bitcoin. At the time of writing, over 6000 different altcoins are listed on coinmarketcap.com [2], the website that maintains the list of all significant public blockchain projects. The first group of altcoins that we will mention in this paper are coins that have Bitcoin in their name Bitcoin Cash, Bitcoin SV, Bitcoin Gold and similar coins that are not only software forks of Bitcoin but also forks of Bitcoin blockchain.

The second group of altcoins is the platform altcoins group. These altcoins allow for very easy creation of tokens. For a small fee, the user can create their own tokens on top of platform altcoins blockchain. Such platforms include Ethereum, Neo, Tron, Waves and similar altcoins.

The third group of altcoins is "masternode" [3] coins group. These coins add another layer onto the Bitcoin foundation. Together with normal nodes, these blockchains include collateralized nodes called masternodes or systemnodes that do special tasks like making transactions private or even further securing the network. Most prominent coins in this category are Dash, Pivx and Zcoin.

The fourth group is stablecoins altcoins group. These coins aim to improve on Bitcoins volatility by being tied to an asset or a group of assets that are much more stable than Bitcoin. For example, Tether (USDT) is a stablecoin that is tied to US Dolar so that one USDT is equal to one United States dollar. Prominent coins are Tether, USD Coin (USDC), Paxos standard (PAX).

The fifth group of altcoins is the exchange altcoins group. As we mentioned earlier, centralized exchanges are a large part of the cryptosphere. Some of these exchanges have their own coins that can be used for trading on the exchange. These exchanges include Binance, Kucoin, Huobi.

The sixth group is the privacy altcoins group. The last group of coins that we will mention in this short review are privacy or enhanced privacy coins. We already mentioned Dash when we talked about masternode coins, but there are privacy coins like Monero [4] that are built to provide their users with total privacy. Unlike Dash where user can choose between private and public transactions Monero supports only private transactions.

Besides public blockchains, there are also private or enterprise blockchains. These blockchains are run by corporations or government institutions with closed groups of participants. Blockchain technologies that are the most prominent examples of technologies used to create private blockchains include Hyperledger [5], Corda and Quorum. These technologies [6] [7] are increasingly being used to create business solutions in many industries. Different types of blockchain applications on both public and private blockchains [6] [7] include business, education, healthcare, internet of things, government, identity verification, financial, data management and other applications.

Security risks of using cryptocurrencies

Cryptocurrencies make it very easy to do financial transactions over the Internet. This very quality also makes them very interesting targets for criminals. Criminals can now easily rob their victims from any place in the world that has an Internet connection. This makes the possibility of being hacked and robbed a permanent security threat. Modern computers and mobile devices are constantly connected to the Internet always syncing and installing new updates.

Everyone can download a cryptocurrency wallet from the Internet and receive money [8]. However, not everyone knows how to keep their funds safe. Besides the possibility of getting hacked, there are many other security risks of owning cryptocurrencies.

One such risk is the risk of losing data due to hardware malfunction or theft. Another risk factor is the unskilled handling of the cryptocurrency wallets. Having complete control over one's money is great, but it comes with great responsibility. If the user lacks the required skills and training, it can lead to very expensive errors. Failure to make regular backups of wallets or private keys can lead to losses.

To mitigate these risks, in the age of cloud computing, there are, of course, multiple online services that offer to store cryptocurrencies on the user's behalf on their servers. These Internet services include cryptocurrency exchanges and online wallet providers. Although this method solves issues of backups and proper data handling it also brings many new challenges with it.

The first problem is the safety of the Internet connection between the user and the service. Users must be able to determine if their connection is secure and then when it is; there is a problem of securely logging into Internet service and mitigating the risk of the user's password being compromised. Safety aware online exchanges offer multifactor authentication as a measure to solve the stolen password problem. According to [8], multifactor authentication can include something that the user knows, something that the user has or something that the user is (biometrics). In practice, two factors are considered to be good enough for most applications. In this way, when accessing the system user is prompted to enter the password (first factor) and then a code that proves that he has access to a device (second factor). In practice, the most used two-factor authentication methods include sending SMS messages with one-time passwords to the user's phone or using a software installed on the user's mobile device to generate a one-time password at the time of login. Most popular two-factor service is Google Authenticator [9] that uses TOTP (Time-based One-time Password algorithm) and HOTP (HMAC-Based One-time Password).

The second problem with online services that store user-owned cryptocurrencies is the safety of the online services themselves. In the last couple of years, many of these services have lost user's funds after being attacked by hackers. Also, there is a business risk of exchanges going out of business and dragging users into endless liquidation processes.

Student motivation

Unlike blockchain technology topics that are very new, the research field of student motivation is a very mature research discipline. Numerous studies have identified student motivation as a significant variable for student academic achievement. A common thread in these studies is identifying internal and external sources of motivation [10] where intrinsic and extrinsic motivational factors explain engagement in education. Ryan and Deci [11] in their Self-Determination theory make the distinction between intrinsic and extrinsic motivation.

Intrinsic motivation [11], in general, is when a person does an activity for itself because it is enjoyable and satisfaction and pleasure derived from participating in the activity. [12] Vallerand et al. mention a taxonomy of three different types of intrinsic motivation: intrinsic motivation to know, intrinsic motivation to accomplish things and intrinsic motivation to experience stimulation.

They define [12] intrinsic motivation to know as "The fact of performing an activity for the pleasure and the satisfaction that one experiences while learning, exploring, or trying to understand something new." So it is a motivation that student has because of the pleasure of learning something new.

According to [12], intrinsic motivation to accomplish things is defined to be "The fact of engaging in an activity for the pleasure and satisfaction experienced when one attempts to accomplish or create something." They give an example of a student that does more than is required just to feel the satisfaction of having written a challenging term paper.

The third form of intrinsic motivation – intrinsic motivation to experience stimulation is when an individual, for example, reads a book [12] that creates intense feelings of cognitive pleasure because of exciting content that it contains.

Extrinsic motivation [11] is the motivation that stems from behaviors that are a means to an end and not motivating for their own sake. Students are motivated to do something because they will reach a certain outcome, like earning points or passing exams and not because they enjoy learning a subject. [12] Vallerand et al. mention a taxonomy of three different types of extrinsic motivation: external regulation, introjection, and identification. External regulation is comprised of externally imposed rewards and constraints for a student that motivation is, for example, when student studies because his parents want him to study and will possibly reward him for good grades. Introjected regulation is,

for example, when a student studies something because it is what is expected. Identified external motivation [11] is when a student has identified with the behavior. For example, a student could say that he is learning about a particular subject because it is important to him.

2. METHODS

In this paper, we used an intersectional survey to gather data about research topics. We surveyed N=84 students. The survey included 41 questions about three topics and four demographic questions. Demographics were used to separate students into two groups IT students and other students, so we can see if there are any significant differences.

The first topic was the student familiarity with blockchain technologies and cryptocurrency; it includes seven yes/no questions. Questions like have they ever used blockchain and cryptocurrencies and how.

The second topic included ten questions about student habits concerning cybersecurity risks. Questions about what operating system they have on their desktop and smartphones. Then questions about using antivirus, doing backups and enabling two-factor authentication.

Third set of questions included 24 Likert scale questions on the topics of their interest and motivation to learn about blockchain technologies. First six questions were about interest in various topics on blockchain technology. Next 18 questions were adapted for our needs from [12]

Their scale includes seven constructs but for our purposes we adopted first six constructs that measure two types and total of six subtypes of motivation.

Construct "intrinsic motivation to know about blockchain" is measured with three questions. It measures intrinsic motivation to learn about blockchain that stems from students enjoying learning something new.

Construct "Intrinsic motivation toward accomplishment" is also measured by three questions. It is designed to measure intrinsic motivation to learn about blockchain that comes from the student's pleasure of accomplishing a task.

Construct "Intrinsic motivation to experience stimulation" is measured by three questions. It measures the component of intrinsic motivation to learn about blockchain produced by intense feelings of reading about something exciting.

Construct "Extrinsic motivation - external regulation" is measured by three questions. It measures external regulation. In this case, external rewards come in the form of a well-paid job.

Construct "Extrinsic motivation - introjected regulation" is also measured by three questions. It measures the introjected regulation component of extrinsic motivation.

Construct "Extrinsic motivation – identified regulation" is again measured by three questions. It measures the identified regulation component of extrinsic motivation. In this case, the student identifies learning about blockchain as important for him and his career.

3. RESULTS

Out of 84 respondents, 53 (63.1%) were IT students, while 31 (36.9%) were non-IT students. By gender, 41(48.8%) were male, and 43 (51.2%) were female.

The first group of questions was about student familiarity with blockchain technologies. Table I shows the results for the first seven questions. 57.1% of the respondents have heard about blockchain. 19% of the respondents have cryptocurrencies. 50% of the respondents know someone who has used cryptocurrencies. Only 8% have invested in cryptocurrencies. 51.2 percent know someone who has invested in cryptocurrencies. The percentage of students who mined/staked cryptocurrencies is 6%. However, 34.5% of the respondents know someone who has mined/staked cryptocurrencies.

Divided into IT and non-IT groups results are the following. 58.5% of IT students have heard about blockchain, and 54.8% of non-IT students have heard about blockchain. 22.6% of IT students have used cryptocurrencies, while only 12.9% of non-IT students have. IT students know more people who have used cryptocurrencies 56.6% compared to 38.7% non-IT students. Also, the number of IT students who have invested in cryptocurrencies is much larger than that of those who have not 13.2% compared to 3.2%. However, when asked if they know someone who has invested in cryptocurrency, results are much more balanced 52.8% compared to 48.4%. On the question about having personally mined or staked cryptocurrencies, 7.5% of the IT students responded affirmatively while only 3.2% of non-IT students indicated that they have mined or staked cryptocurrency. On the question, if they know anyone who has been producing cryptocurrencies, 37.7% IT students responded affirmatively while only 29% of non-IT students responded affirmatively.

Question	*Yes(%)*	*No(%)*
Have you heared about blockchain?	57.1	42.9
Have you ever used cryptocurrencies?	19	81
Do you know someone who has used cryptocurrencies?	50	50
Have you invested in cryptocurrencies?	9.5	90.5
Do you know someone who has invested in cryptocurrency?	51.2	48.8
Have you produced (mined/staked) cryptocurrency?	6	94
Do you know someone who has produced (mined/staked) cryptocurrency?	34.5	65.5

Table 1. BLOCKCHAIN AND CRYPTOCURRENCY USE

For second group of questions we got following results. First question was about desktop operating system. 83 out of 84 respondents (98.8%) are using Windows operating system and only one (1.2%) is using Linux desktop operating system. For mobile operating systems 61 respondent (72.6%) is using Android operating system and 23 respondents (27.4%) are using iOS operating system. On the question if they are using antivirus on their desktop computer 85.7% said yes. For mobile phones percentage of respondents that are using antivirus is much less 40.5%. 59.5% of the respondents makes backups of data on their desktop and 79.8% of the respondents makes backups of data on their mobile phones. Two factor authentication is used by 34.5% of the respondents. Last three questions in this group were about lost data. Total 33.3% of the respondents have lost their data due to computer virus, 28.6% of respondents lost data due to hard drive failure and 39.3% of the respondents lost data due to loss of the mobile phone.

Then we compared IT and non-IT students and got following results. Only student that uses Linux operating system is an IT student and all other students use Windows on their desktop computers. IT students use Android in greater percentage 75% compared to 67.7% for non-IT students. More non-IT students use antivirus, both on desktop (93.5% vs. 81.1%) and mobile phone (58.1% vs. 30.2%). Bigger percentage of non-IT students backs up data. On desktop computers 67.7% compared to 54.7%. On mobile phones 83.9% versus 77.4%. Bigger percentage of IT students uses 2FA 37.7% compared to 29% of non-IT students. Non-IT students had more problems with losing data. 45.2% of non-IT respondents lost data due to computer virus while only 26.4% IT students lost data due to computer virus. Hard drive failure led to the loss of data for 35.5% of the non-IT students compared with 24.5% of the IT students. Loss of mobile phone led to the loss of the data for 51.6% of the non-IT students compared to 32.1% of the IT students.

Next six questions were about different reasons why students are interested in learning about blockchain. Results are presented in the following paragraphs and can be seen in table II. On the Likert scale from 1 to 7 where 1 is “I completely disagree” and 7 is “I completely agree” students scored their interestedness about the different aspects of the blockchain technologies.

Question	*Mean*	*Std. Deviation*
I am interested to learn more about blockchain technologies	4.46	2.05
I am interested to learn more about cryptocurrencies	4.79	2.083
I am interested to learn more about business application of blockchain tachnology	4.52	2.074
I am interested to learn more about using cryptocurrencies safely	4.68	2.043
I am intersted to learn more about production (mining) of cryptocurrencies	4.24	2.189
I am interested to learn more about blockchain programming	4.36	2.075

Table 2. INTEREST IN LEARNING ABOUT BLOCKCHAIN

Questions about interestedness in blockchain technology by group			
Question	*Group*	*Mean*	*Std. Deviation*
I am interested to learn more about blockchain technologies	IT	4.74	2.123
	Non-IT	4.00	1.862
I am interested to learn more about cryptocurrencies	IT	4.89	2.118
	Non-IT	4.61	2.044
I am interested to learn more about business application of blockchain tachnology	IT	4.68	1.998
	Non-IT	4.26	2.206
I am interested to learn more about using cryptocurrencies safely	IT	4.85	2.032
	Non-IT	4.39	2.060
I am intersted to learn more about production (mining) of cryptocurrencies	IT	4.58	2.179
	Non-IT	3.65	2.106
I am interested to learn more about blockchain programming	IT	4.66	2.009
	Non-IT	3.84	2.115

Table 3. INTEREST IN LEARNING ABOUT BLOCKCHAIN BY GROUP

We then compared IT and non-IT students. Results can be found in table III.

Last eighteen questions measured six student motivation constructs results can be seen in table IV. Mean value for construct "Intrinsic motivation – to know" is 4.43 with Cronbach alpha 0.906. For construct "Intrinsic motivation – toward accomplishment" mean is 4.44 with Cronbach alpha of 0.889. Mean value of construct "Intrinsic motivation – to experience stimulation" is 4.44 and Cronbach alpha 0.91. Extrinsic motivation constructs mean values are 4.73 for identified, 4.14 for introjected and 4.48 for external regulation. With Cronbach alpha values respectively 0.911, 0.921 and 0.937.

Question	*Mean*	*Std. Deviation*	*Cronbach alpha*
Intrinsic motivation – to know	4.46	2.05	0.906
Intrinsic motivation – toward accomplishment	4.79	2.083	0.889
Intrinsic motivation – to experience stimulation	4.52	2.074	0.91
Extrinsic motivation – identified regulation	4.68	2.043	0.911
Extrinsic motivation - introjected regulation	4.24	2.189	0.921
Extrinsic motivation - external regulation	4.36	2.075	0.937

Table 4. STUDENT MOTIVATION TO LEARN ABOUT BLOCKCHAIN

Afterwards we compared motivational constructs values for both IT and non-IT groups. Results of this comparison can be found in table V.

Question	*Group*	*Mean*	*Std. Deviation*	*Cronbach alpha*
Intrinsic motivation – to know	IT	4.65	1.81	0.905
	Non-IT	4.05	1.90	0.869
Intrinsic motivation – toward accomplishment	IT	4.71	1.65	0.876
	Non-IT	3.96	1.82	0.898
Intrinsic motivation – to experience stimulation	IT	4.59	1.75	0.889
	Non-IT	4.18	1.90	0.938
Extrinsic motivation – identified regulation	IT	5.01	1.70	0.877
	Non-IT	4.24	1.93	0.949
Extrinsic motivation - introjected regulation	IT	4.32	2.01	0.927
	Non-IT	3.83	1.93	0.907
Extrinsic motivation - external regulation	IT	4.67	1.86	0.933
	Non-IT	4.16	2.08	0.942

Table 5. MOTIVATION TO LEARN ABOUT BLOCKCHAIN BY GROUP

4. DISCUSSION

In the first part of the survey students gave answers about their familiarity with blockchain and cryptocurrency. Students have generally heard about the blockchain and know people who have used it. However, percentage of students that have actually used cryptocurrency is very low. Only 19% of the respondents have actually used cryptocurrencies.

Almost all respondents 83/84 use Microsoft Windows operative system on their desktop computers as we expected. Microsoft Windows is definitely dominant operating system for desktop computers. It is however not the safest operating system. Linux and Apple's operating systems are safer options.

For mobile devices there is not much choice two most popular operating systems are Android and iOS. Mobile operating systems are much more resistant to security threats. Android which is open-source is less safe than Apple's iOS which is completely closed platform. Percentage of respondents that uses Apple device's (27.4%) is very significant considering that their devices are much more expensive and that at the time that survey was conducted Apple didn't officially support Serbia. Although mobile devices are much more resistant to viruses and malware it is still recommended to have

antivirus or some variant of antimalware software just to be sure especially if one has a jailbroken device.

Since 85.7% of respondents have antivirus on their desktop computers and 40.5% have antivirus on their mobile phones we can say that they are very responsible concerning the computer virus threat. However, when we group respondents by IT and non-IT students we discover some very interesting facts. IT students are less responsible than non-IT students. Fact that 93.5% of non-IT students use antivirus on their computers and only 81.1% IT students have antivirus on theirs is very worrying. And this is not the only area where IT students are less responsible, smaller number of IT students backs up data.

Results for the rest of the data security questions are as expected. Bigger percentage of IT students uses 2FA and bigger percentage of non-IT have lost data in incidents related to viruses, hard drive failure and loss of mobile phone. Percentage of respondents that use 2FA is very small (34.5%). Fact that every other non-IT student and every third IT student has lost a mobile phone is also something that is very worrying. Mobile phone cryptocurrency wallets are very popular and loss of mobile device would equal the loss of cryptocurrency if one does not have a backup.

There is a large difference in interestedness in learning about blockchain and cryptocurrency. IT students show interest in all aspects of blockchain technology and non-IT students show interest only in topics about cryptocurrencies and their safe use.

Topic of motivation is the part of this research where differences between IT and non-IT students are most evident. On a seven point Likert scale four marks neutral position and results for non-IT students are very close to four (table V). This shows that non-IT students are not very motivated in learning about blockchain which is expected. Extrinsic motivation factor of identified regulation has the highest mean score of all motivation factors with a mean of 4.24 and that is quite low.

IT students on the other hand are much more motivated to learn about blockchain which is normal considering that they are studying information technology. Intrinsic motivation construct mean values are at very similar levels which could mean that students are intrinsically motivated to learn about blockchain. Of the extrinsic motivation constructs identified regulation is the strongest and introjected regulation is the weakest. It is interesting that the fact that knowledge about blockchain can help their carrier is more of a motivating factor than that fact that blockchain and cryptocurrency jobs are currently one of the best paid in IT industry.

5. CONCLUSIONS AND FURTHER RESEARCH

Respondents are aware of the existence of blockchain technologies, majority of them has heard something about blockchain and cryptocurrency and know someone who have used it in some way. Relatively small percentage has used cryptocurrency personally. These numbers are likely to grow over time and following the rate of their growth could be an interesting direction of further research. Respondents are aware of security risks that come with storing valuable data. Large percentage uses antivirus and makes backups. IT students are less responsible in this regard. Reason for this irresponsibility remains unclear and is a possible topic for further study. Topics in which IT and non-IT students differ the most are topics of interestedness and motivation to learn about blockchain. IT students show interest and are motivated to some extent to learn about blockchain. Non-IT students with exception of couple of topics neither show interest nor are motivated to learn about blockchain. This leads us to the conclusion that any similar further studies of this type should be focused primarily on IT students.

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