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TEACHING EMERGING TECHNOLOGIES AT THE INTERNATIONAL LEVEL VIA THE INTERACTIVE METHODS

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Abstract: This research focused on the experience of teaching emerging technologies to students of different specialties via the use of interactive methods. In particular, the learners were presented to the topic of the blockchain technologies through the deliberately designed role game "The Blockchain Game," a hands-on exercise that explains blockchain's core principals and serves as a launching pad for the discussion of Blockchain's real-world applications. This inexpensive, no-computer, exercise has been used in higher education and professional organizations in the US, Germany and Ukraine. This data will be used to improve the current exercise and to develop additional low-cost teaching aids that can be used globally to help prepare students of all ages adapt to the technology of the 4th industrial revolution.
The research goal was to analyse the experiences of introducing emerging technologies via interactive methods using the feedback of the students from two countries. Blockchain technology can be a game-changer for accounting, supply chain, banking, contract law, and many other fields. But it will only be useful if lots of people trust and adopt it. The conclusions were delivered under the context of the student's feedback and analysis of their performance during the game. The paper highlights the importance of identifying good practices in the presenting of the emerging digital technologies to a wider audience under the context of the quality assurance standards for modern education.
In addition, the authors are assessing the effectiveness of this exercise and trying to identify any cross-cultural differences that might affect the efficacy of such a simulation. The low computer literacy, absence of skills in personally adopting the newest technologies, combined with low availability in the educational process can result in challenges for teaching about these technologies and their application.

Introduction

Information and Communication Technologies (ICT) became the key tools on the path of 21st century development, and they will stay the leading factor during the next generations' lives. That is why the ICT implementation into the educational process as a working instrument as well as a knowledge component should be an implicit part of the modern training. Knowledge globalization, fast speed of the information accumulation and processing causes a need to design the new approaches to the educational process. (Bezzub 2016) The higher education as an industry has been functioning for a long period with certain stability and steady profits until the moment of entering the era of the digital technologies. As a logical result of the massive implementation of digital technologies into a lot of spheres and the areas of society's activities, humanity is already able to witness their influence (Kuzminska 2019, 148-170).

The people are experiencing the digital economy advent, the basic elements of which are electronic business operations, and a boost of the relevant infrastructure and e-commerce. That is why digital transformation allowing to launch new business models based on networking effects are in the focus of attention both of the educators and practitioners (Kaminskyi et al. 2018, 128-137). **All around the world** virtual reality and personalized learning powered by artificial intelligence are already employed to provide

a better quality of the training experiences for the students. It is estimated that the global edtech market will reach 93.76 billion USD by 2020 (Ayers 2019). Similarly, blockchain is expected not transform industries and education.

Ukrainian educational institutions are involved in the global processes of digitalization and work on engaging the up-to-date trends into their activities, as do American universities. Many universities shift towards ICT use in their educational electronic resources, distance courses and technical devices used for learning. This, of course, changes the grounds of the educational process organization and maintenance. (Buhajchuk 2016) According to the study of Blayone et al. (2018) large percentages of Georgian and Ukrainian students are ill-prepared for many online-learning activities in technical, communicational, informational and computational dimensions (Blayone et al. 2018). Consequently, the modern education system experiences difficulties in merging the various technical solutions with the existing system elements and the educational agenda that has been practiced for years. Using the concept of a convergent cloud-oriented platform, some Ukrainian authors offer the universities to create a space for the digital interaction which would involve the entire education system (Kaminskyi et al. 2018, 128-137). However, while in Ukraine it is only the idea, leading American universities are already there: MIT is a leader in a blockchain-based open standard for verifiable digital records (Director's Fellows program, 2015 for the first time) (Raths 2016); Central New Mexico Community College began issuing "student-owned digital credentials" on a blockchain platform; the City College of New York is assessing bitcoin as a method of payment (Kevin 2019).

Another interesting experience was introduced by the University of Nicosia (Cyprus), a pioneer of the full-scale blockchain implementation in the educational sphere, which has already launched a blockchain library for storing students' grades, diplomas and certificates. The students of this private institution are also able to pay school fees using bitcoin (Universa 2018). Russian platform "Disciplina" was the first to engage the blockchain technology solely for education and recruiting purposes by launching the "TeachMePlease" application. Another blockchain platform "Opet Foundation's" chatbot app was designed to help students with test preparations by answering questions and recommending resources. The track of a student progress will be kept via the blockchain (Kaminskyi et al. 2018, 128-137).

The analysis of all the existing experiences and efforts of introducing the blockchain technologies into the daily life of the humanity, makes it important for all the stakeholders, including the educators, to reflect on all possible implications the blockchain might have. The more it is considered for the daily use, the more areas of application arise from tracking student's/worker's absences to managing homework/tasks deadlines. It can also be useful if a university or an organization are paralyzed by a crisis situation, for example, war, when the blockchain will save the documents kept in conflict zones (Aashish, Sharma 2018).

Nevertheless, the potential impact of the blockchain on academia and the rest of the organizations goes far beyond cryptocurrency and immediate solving the problems. This technology is able to improve the learning quality and provide the increased support and opportunities for teachers, parents and other stakeholders. Some authors notice that the higher education system has been evolving into a distributed model for certain period of time already: the colleges and universities combine their resources for the sake of better effect. For example, there is an Internet 2 Net+ Initiative that provides a range of application, computing and other cloud-based services which may use the blockchain's peer-to-peer transaction-based model. Blockchain could be used in moderating digital content and protecting digital rights, as well as in the evolution of "community content repositories" (the inspiring example of San Jose State University which is a leader in the Library 2.0 movement) (Kevin 2019).

There are also other areas of the emerging digital technologies use: blockchains in healthcare reduce the impact of cybercrime and raise the data security; Sony Global Education designed a centralized modern ledger powered by the blockchain for storing education records and enables data from various education institutions to amalgam together; Bitdegree is the world's first blockchain-powered online education platform with token scholarships and blockchain-based achievement tracking (Soluloid 2018).

According to the "digital skills" index of the European digital economy and society index in 2017 44% of the EU population lacks skills in using digital technologies, while they are recognized to be one of the eight key competencies for a fully successful life nowadays (Digital-agenda data 2005). As a logical conclusion, **the blockchain must be among the emerging technology skills** that will be expected by the employers from the future graduates in the coming years. There are the classes that train the programming skills, but the blockchain technology became a unique educational challenge as it is at the intersection of such areas as: business, commerce and transactions, technology and artificial intelligence, policy and law, intellectual property rights and cryptography. That is why teaching the blockchain requires a certain interdisciplinary approach. There are already such educational programmes and environments that combine several of the mentioned areas, such as the programmes offered by the Berkeley Centre for Law and Business or Cornell Blockchain. They aim at the development of the blockchain skills and growing projects (Kevin 2019).

The blockchain and smart contracts potential is clearly seen in helping to run businesses, exchange goods and services, buy real estate, collect and analyse data, issue educational credentials. Smart Contracts, as the self-executing digital deals, are already essential to any business using the blockchain because they help to reduce costs and increase the security avoiding the need for third-party intervention. (Blockchain App Factory 2018) KnowledgeWorks investigated how blockchain and smart-contract technologies could improve learning, its conditions and personalized learning in the United States. The project was aimed at

developing the capacities to design and sustain vibrant learning ecosystems via engaging the learners into exploration of emerging technologies abilities (King, et al., 2018). An interesting experience of the use of blockchains is to connect the labour supply and demand in specific settings such as in refugee camps is offered by the Karvan project. It is aimed at connecting the refugee-centred NGOs with refugees who can provide special skills or camp members with other inhabitants, as well as fix the volunteers' time invested in working with refugees (Ivancsics 2019).

A "Learning is Earning 2026" platform uses a basic curriculum model with a fragmentation of the program in small blocks that the students complete according to their needs and skills. Then passing of each unit is translated into a smart contract that is supposed to be resolved when the student has reached a satisfactory level (Bartolomé et al. 2017). However, online studies have different features then face-to face education and the approach to setting the educational scheme with the use of interactive methods and gamification is still an obligatory step. This requires certain principles, such as: clear information, relevant practice, informative feedback, motivation and balance between the task difficulty and the level of the student (Lyashchenko, Hryshunina, Pichkur 2018).

Competency-based approach in the modern higher education drives to the need to improve the productivity, knowledge, skills and other personal qualities via practice-oriented methods. That is why the way to explain the blockchain technology via a game that allows experiencing the whole philosophy of the blockchain is expected to be the most effective. Most people do not know about the term "blockchain", not to mention the potential applications of using blockchain technology. Although a lot of developers and practitioners, as well as researchers discuss the usage of blockchain in the current commercial area, there is a few studies focused on how to teach the blockchain technology in the most effective way. **The current research goal** was to analyse the experiences of the emerging technologies introduction to the educational process via the interactive methods using the feedback of the students from two countries: the USA and Ukraine.

Under the pressure of modern business speed and trends, forward-thinking companies struggle with tackling with blockchain solutions in order to use their potential to improve own business results. The blockchain is able to drive innovative mobility services, ensure data stewardship and the accuracy of public records, maintain the supply chain traceability, secure voting and secure the financial transactions. (IBM Blockchain 2018) According to the "Development Strategy of the Innovative Activities Field up to 2030" determined by the Cabinet of Ministers of Ukraine (Strategy for development of the sphere of innovative activity for the period till 2030, 2019) it is expected to stimulate the increase in the use of ICT, commercialization of the innovative solutions and increase of the profits coming from the intellectual

property rights use. In order to achieve this more citizens, we need to understand blockchain technology and its potential.

The Methods Used to Analyse the Experiences of Teaching the Blockchain

As one of the blockchain games researchers, Dave Their, stated: "There's blockchain, and there's gaming". Blockchain has become more of the economy element rather than just bits of code with pseudo-physical presence, it has created the next level of the Web which is "the Internet of Value". For example, the Horizon Blockchain Games Inc. offers its players to own and trade their digital items across an Internet and is currently building an Arcadeum platform for the developers to work on their own blockchain-based games. (Their 2019) Not all of the game companies fully see the potential of cryptocurrency and blockchain that gives a chance to those start-ups working on the intersection of games and the new technology to develop faster and more successfully. Brock Pierce, a chairman of the Bitcoin Foundation, who once was one of the first blockchain investors, became a No. 9 in cryptocurrency wealth within the Forbes rates (VB 2019).

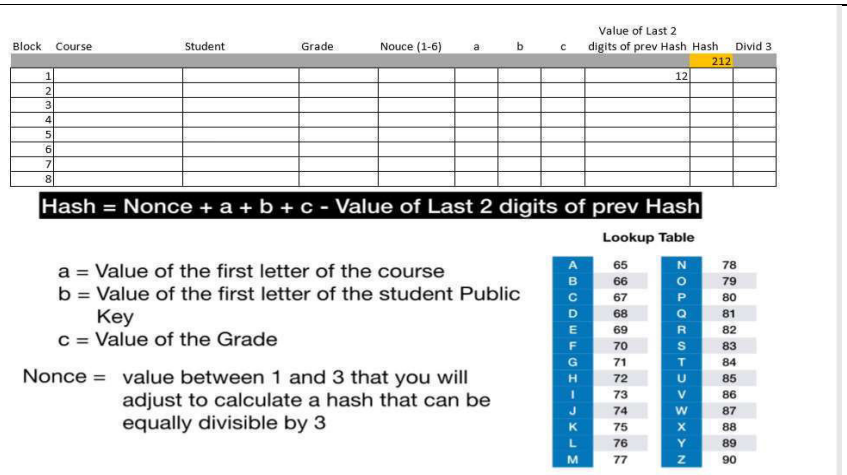
Both for teaching and for developing gaming systems, however, it is important to design a proper set of mind. The Blockchain Game Alliance is committed to promoting blockchain within the modern game industry. They work on dissemination of awareness about blockchain technologies and encourage to foster new ways to create something else around games (BGA 2018). There is also another game that can help to understand the underlying essence of the blockchain-based game we are going to analyse in this paper. The Beer Game (https://beergame.org/) demonstrates the difficulties of managing the dynamic systems. It comes from the late 1950s, MIT, the USA, and introduces the concepts of dynamical systems where different playing strategies may be applied (Grasl 2015).

The Blockchain Game was designed by a teaching professor and technologist J Scott Christianson, Trulaske College of Business of the University of Missouri, USA, for teaching blockchain technology without the use of computers. During the activity the students simulate the computer work and calculate the blocks themselves. They are divided into nodes and miners on a blockchain network which pretends to store some random university students' grades. A group of volunteers are chosen to be the "faculty members" and a separate group are chosen to act as "students", who are given an ID number – called a public key – to access their grades during the exercise. Each public key is one-half of a key pair that includes a private key. The participants record the grade and course data and then they build the block by calculating a hash which secures the grade ledger. The special nodes called miners both validate and execute the transactions on the blockchain and as a result of the simulation the miners find out which answer is accepted by the network to become the right one. The first student to solve the puzzle earns a reward for hashing that block. Hashing within this simulation is the process of solving a complex mathematical puzzle to validate and append new blocks to the blockchain. This gives the students a hands-on experience on dealing with the blockchain system elements (hashes, private keys, etc). A group discussion is supposed to follow the game raising the

topic of the other possible blockchain applications and whether storing student grades is a good use of blockchain technology. The game doesn't use any computers because the participants simulate them. The Blockchain Game is available in English and German translations, and Mr. Christianson has made all of the exercise materials available for free for this he encourages educators/trainers to send their feedback (Fadilpasic 2019, Grimes 2019).

At the personal web-site the author has made all the game materials public (Christianson 2019 b), the slide deck that may be used to lead the audience through the exercise, Apple Keynote and MS PowerPoint versions are provided; game printouts; a MS Excel file with a blockchain ledger that has already been calculated along with a blank ledger (see Picture 1).

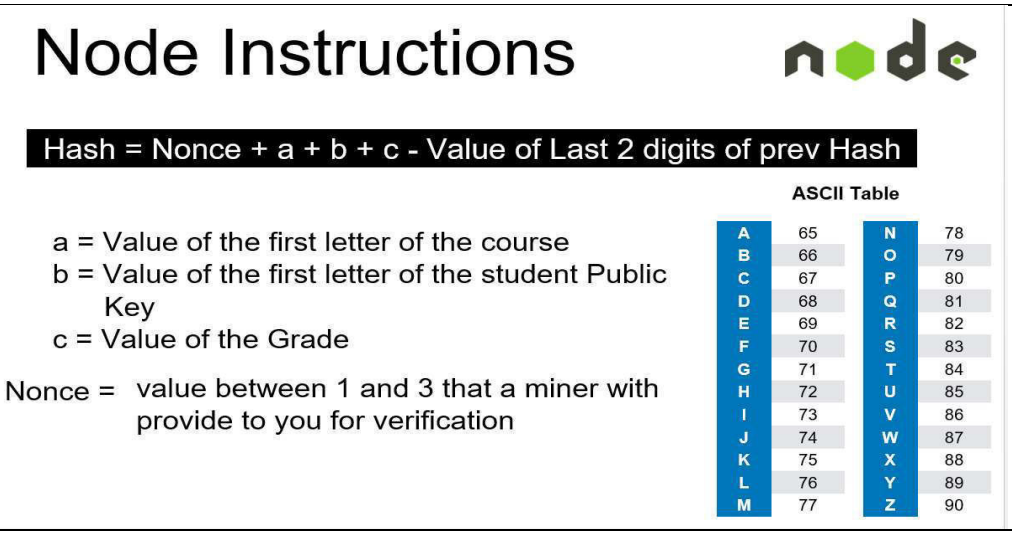
PICTURE 1. NODE INSTRUCTIONS PAGE



Souce: (Christianson 2019b)

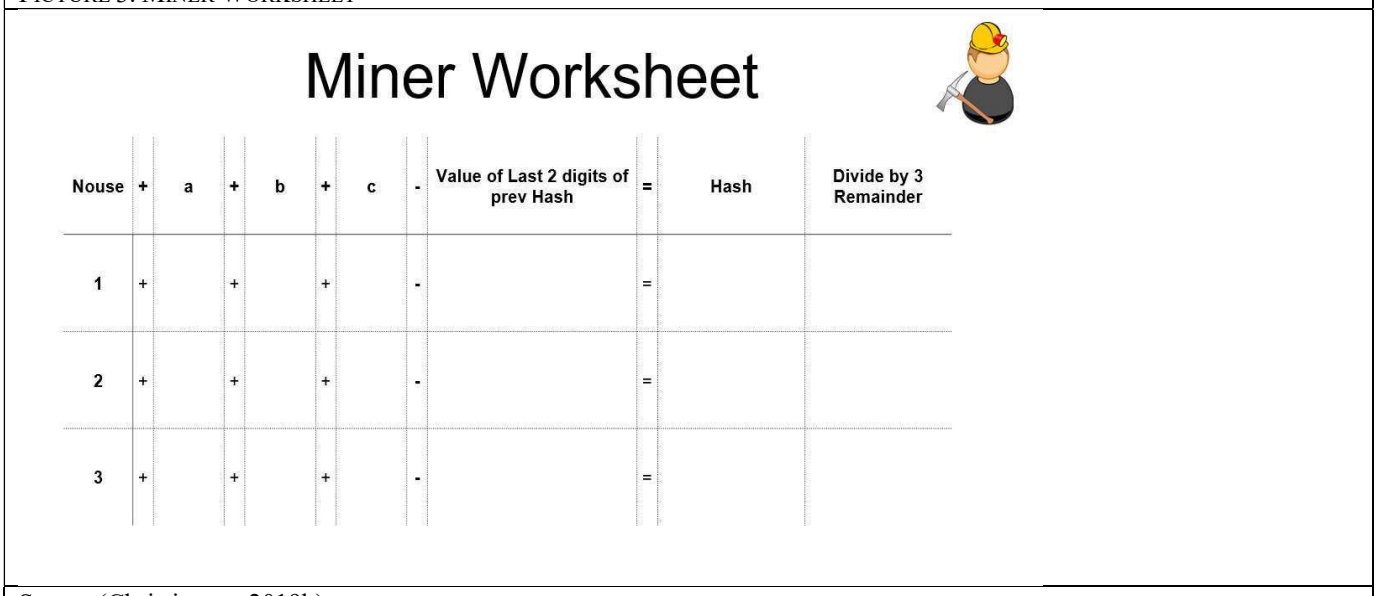
An attendee handout that allows those who are not miners or nodes to follow along and understand better what is happening. Teaching materials needed are simple as well: pencils, student key pair sheets, "node packets" (node instruction sheet (see Picture 2), blank grade ledger), "Miner Packets" (miner instruction sheet, blank grade ledger, Miner Worksheet (see Picture 3), Prizes for Miners).

PICTURE 2. NODE INSTRUCTIONS PAGE



Souce: (Christianson 2019b)

PICTURE 3. MINER WORKSHEET



Souce: (Christianson 2019b)

To analyse the results of this game implementation into the educational process of three higher educational institutions, the authors have designed the survey which was applied before and after the game conduction and then applied the analytically descriptive methodology. Thus, the research analyses the real-life cases of the game conduction in Ukraine and the USA. It is supported by a bibliographic review and concluding arguments to use the interactive game for the development of the competences in the blockchain technology.

Analysing The International Experiences of Blockchain Introduction into the Learning Process

Nowadays, some universities and institutes have already applied blockchain technology into education either as a helping tool or as a part of the educational programme, but most of them use it to support academic degree management and summative evaluation for learning outcomes (Sharples and Domingue 2016). Distributed ledger technology promises transparent, secure applications that can be accessed by students, employees and employers to verify educational records independent of provider or location (Walsh 2019). If the blockchain is taught, then it would be the ICT-related specialty while business- and management-oriented specialties do need the comprehensive understanding of the technology as well. The criticism of the blockchain technology potential to transform the education implies reducing education to evaluation, and the evaluation to the simple certification of competencies (Bartolomé et al. 2019).

Namely this kind of argument motivated Mr. J Scott Christianson, as an educator, to search for the ways to teach students about blockchain technology without overwhelming them with loads of technical details. He was also challenged to design a hands-on exercise that could be applied to any group of students from high school students to adults (Christianson 2019a). This game is also aimed at launching the discussion of blockchain's real-world applications among the students of different academic backgrounds (Christianson

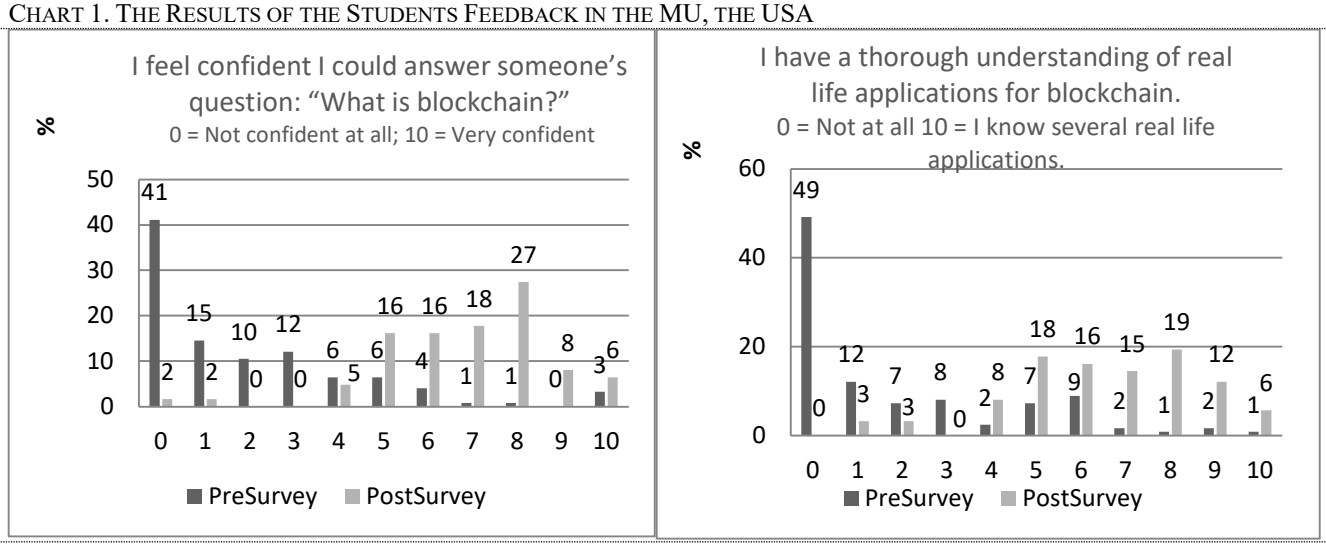
2019a). This inexpensive, no-computer, exercise has been used in Higher Education and Professional Organizations in the US, Germany and Ukraine.

The survey which was designed to analyse the effectiveness of the interactive and gamification approaches via a set of questions asked before the start of the game and after its end. The questions were the following:

1. I feel confident I could answer someone's question: "What is blockchain?"
2. I have a thorough understanding of real life applications for blockchain.
3. Information stored in a blockchain can be modified later.
4. Blockchain prevents fraudulent changes to the ledger from occurring.
5. Which of the following describes the blockchain ledger?
6. A central authority ensures the validity of blockchain transactions.
7. Only certain individuals on the blockchain can see the transactions occurring.
8. If a private key is lost, it can be retrieved from the central server.

As it could be logically expected the trend of the answers were the same for each question, for example, here is an example of the survey results for the two key questions. Chart 1 presents the results obtained at the American university:

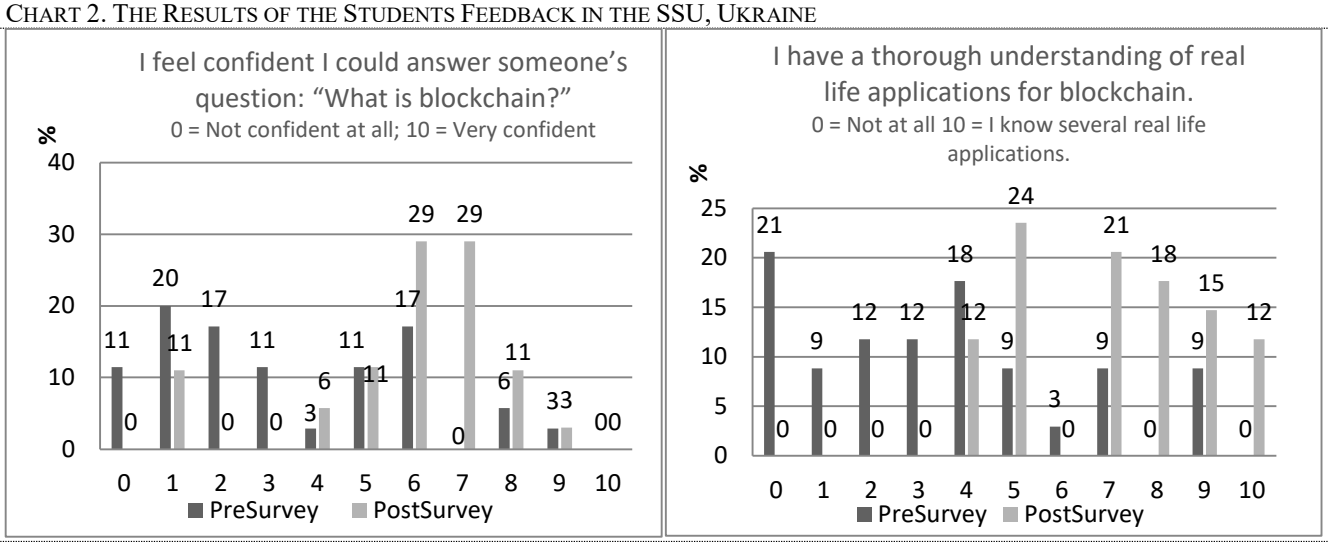
CHART 1. THE RESULTS OF THE STUDENTS FEEDBACK IN THE MU, THE USA



Source: Own.

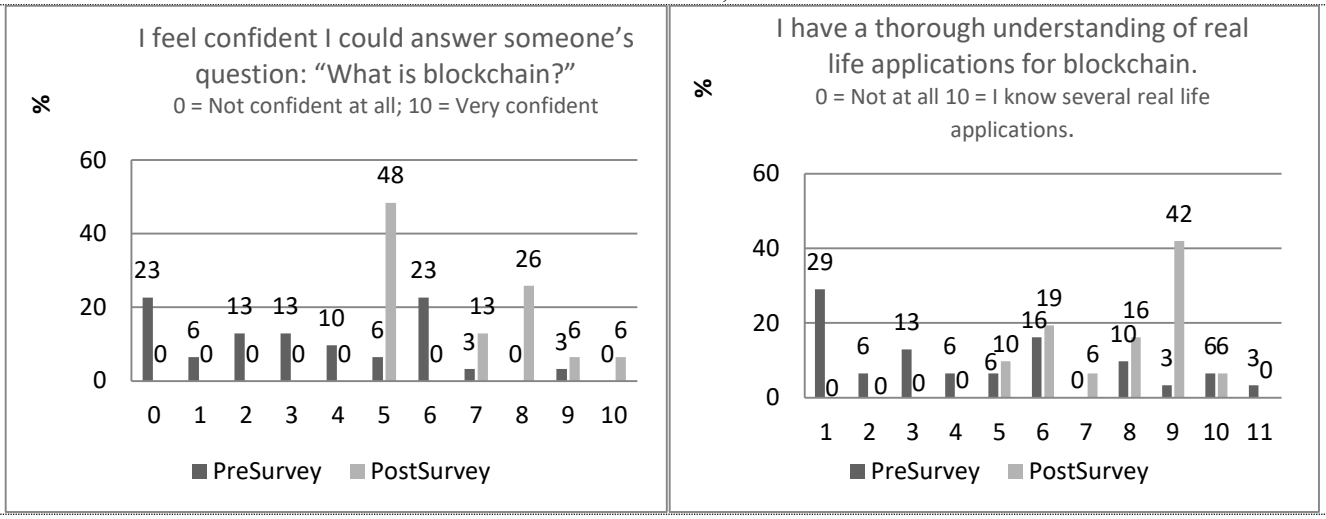
Chart 2 and 3 present the results obtained at two Ukrainian universities:

CHART 2. THE RESULTS OF THE STUDENTS FEEDBACK IN THE SSU, UKRAINE



Source: Own.

CHART 3 THE RESULTS OF THE STUDENTS FEEDBACK IN THE SNAU, UKRAINE



Source: Own.

The results analysis states that at least 10% of the respondents didn't know the answer on a certain question before the game (the share raises up to 60% for some questions which requires specific knowledge background about the game) and at least 3-6% of the respondents improved their knowledge after the game (the share raises up to 50% for some questions).

As an experiment shows, the absence of the interaction during the game and discussions afterwards decreases the percentage of the students that have improved their knowledge about the blockchain, as well as its philosophy and possible implications. During the game and during the discussion afterward the most frequently asked questions were:

1. What is the difference between blockchain and bitcoin?
2. What if a private key is lost?
3. Is it really a good idea to store grades on a blockchain?
4. How do you determine what is a good application for blockchain?

5. How can people hack a blockchain?
6. How would this be used in [accounting, supply chain, finance]?
7. Is bitcoin worth anything?

The main conclusion after the game practicing is that, for the blockchain to make a significant impact on the society life with all the potential it has, grassroots-level change in its understanding is definitely required, as well as collaboration from all the stakeholders: from educators to practitioners.

Conclusion

According to one of the whitepapers of the Cognizant, an American multinational corporation that provides IT services, the current adoption rates of the blockchain will continue to increase and that is why the blockchain's learning and implementation raises comprehensive technological, operating and business modelling issues. It also demands collaboration of the different parties to experiment and deploy the philosophy of the distributed ledger technology (Cognizant 20-20 Insights 2019). To conclude our research, we note that active learning methods modify the role of the teacher from the translator of the information to the organizer and coordinator of the educational process, which makes it possible to form complex competences via the students' direct engagement in the hands-on practices like our game. The experiment results demonstrate that both in the USA and in Ukraine from 3 to 50% of the game participants benefited from the experience. In addition, there were no cross-cultural differences identified during the experiment that could have affected the efficacy of such a simulation. The main challenges for teaching about the blockchain were caused by the low computer literacy, absence of skills in personal adoption of the newest technologies, combined with low availability in the previous educational. This was discovered mostly during the group discussions and personal feedback of the game participants.

It should be noted that the game is not limited to the presented core concepts and is open for any useful modification and a wise expansion to other concepts like smart contracts, supply chain, etc. Due to the relevant changes of the teachers, the students can learn about anonymity, decentralization, and immutability of the shared ledger (blockchain). The potential of the game may be increased in order to discover the blockchain implications as a system of centralized data logging to a distributed system that ensures the maintenance of privacy.

However, the game designer willing to unveil the blockchain full potential must remember that the major challenges lay with the difficulties of its not easy and immediate implementation because of the social, technological and economic reasons, as well as challenges in areas of functionality, privacy, transparency, and possibly the changes which are not always desirable. The main aim of gamification to foster human motivation and performance towards a certain activity (Sailer 2017) – blockchain in our case, was achieved. At least 30% of the game participants in both examined countries - Ukraine and the USA – expressed their motivation to learn more and work over the possible application of the blockchain in their future professional

activities. The number of researchers and practitioners already conduct the investigations on how the blockchain technologies impacts on the currently existing business models (Morkunas, Paschen, Boon 2019) (Angelisa, Ribeiro da Silva 2019).

There are several drawbacks to this exercise, as there are with all instructor lead activities. First, it relies on the instructor making no mistakes when giving directions to the students or walking them through the exercise. If the wrong directions are made, it can be very difficult to get the group back on track. As such some practice sessions are recommended. If students don't have a basic understanding of a standard ledger, it can also be very difficult for them to understand the significant differences between a central and distributed ledger.

A growing interest in the technology demands the necessity to open critical minds combined with the personalized learning and caring educators. Current technologies vision and the cultural mindsets may shift in the future to a different direction and because of these uncertainties about the potential impact of smart transactional models on education and business demands from the educators a more comprehensive teaching approach. It is not enough to teach about the blockchain, it is necessary to set a proper understanding of the philosophy how to apply alike technological solutions. This will help the students to be ready for the major social and technological shifts that may come in the nearest future of the human development.

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