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BLOCKCHAIN IN TOURISM AND BC MODEL FOR EDUCATION OF THE STUDENTS IN TOURISM SECTOR

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Abstract

The Fourth Industrial Revolution brings us changes in digital technologies, using Artificial Intelligence (AI), Blockchain (BC), Machine learning, robotics, simulations, Internet of things (IoT), Nanotechnology, 3D printing etc. The aim of this paper is to present the possibilities of applying modern technologies in the education of students in tourism sector, with special emphasis on the application of blockchain technologies (BCT) as well as to bring the specifics of these technologies closer to the readers. In this paper is proposed a model of student education based on BCT. In addition, evaluation the students knowledge on application new technologies in this area is presented in the paper.

Key Words: *blockchain, digitalization, education*
JEL classification: *I20, Z32*

Introduction

Digitalization significantly increased over the past decade. The digital revolution is influencing all. New technologies make people and companies more efficient and effective and a recent pandemic has confirmed that digitalization is necessary in almost all spheres of life and industries. It pushed forward development of new business models, organization and processes. Dynamic and complex industries such as tourism which are linked to many aspects of modern life need to be quick in adopting new technologies to effectively respond to new challenges. In the study of (Hadjielias, 2022), a survey was conducted among tourism providers on the

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importance of internet-based technologies in their daily work, i.e. in "reaching customers, in creating, integrating, and customizing new services, and in delivering customer value".

However, digitalization is not only the question of introducing new and contemporary technology, but education of people and their professional development along with the changes obtained by technology. The implementation of digital technologies requires the engagement of multidisciplinary teams of professionals who would initiate and use new technologies. "The lack of digital skills has been identified as a major obstacle to exploit opportunities by digital technologies in tourism." (Dredge et al., 2019).

Researching the curricula of various high education institutions (HEIs) in Europe that deal with the education of students in the field of Information and communications technology (ICT) and tourism, there is a gap in this area. Apart from sporadic subjects in undergraduate studies, only a few master's courses deal with this issue to a greater extent. Bilotta et al. (2021) in their work presented the results of teaching experiment[3] to show that through a quality syllabus and carefully selected subjects, in relation with technologies of the I4.0, it is possible to keep up with current topics and requirements of the tourism market.

Having in mind the above, this paper explores the knowledge of new technologies and their application among students of different specializations, with special emphasis on blockchain technology. In addition, the paper proposes a model based on blockchain technology in the education of students of tourism specialties together with some topics from new technologies related with tourism. The proposed model also provides the possibility of evaluating projects at faculties in different area of specialties, but also at e-learning systems with a large number of students (Xu et al., 2021; Piech et al., 2013, Luo et al. 2014).

Blockchain technology concepts

ICT and connected technologies in different sectors such as Cloud (Paunovic et al., 2018), Artificial intelligence and robotic (Lu et al., 2021; Christou et al., 2020), Simulations (Gajovic et al., 2018),

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Telecommunications (Stefanovic et al., 2012), Soft computing techniques (Paunovic et al., 2019), Graph theory (Turab et al., 2021), Digital marketing (Tsourgiannis & Valsamidis, 2019), Image processing (Ralevic & Paunovic, 2021; Ralevic et al., 2020), Energetics (Savic & Savic, 2015), Education and BT (Bjelobaba, et al., 2022) etc. facilitate work and interaction with the market, added value to the customer experience, enable participants to become more competitive and more productive, driving customer demand and increasing revenue.

There is an increasing number of examples of connecting new technologies such as the case of blockchain. Many tourism market participants have begun to invest in the adoption of blockchain solutions (for example, TUI, some airports such as Geneva Airport, Heathrow Airport, and Miami International Airport, airBaltic S7 Airlines etc). "The tourism blockchain solutions are emerging exponentially, yet among the most popular ones are WindingTree, LockTrip, TravelChain, Tripago" (Tyan et al., 2020).

To explain the use of BCT in tourism, we will give a simple example. Imagine that person B wants to stay in an apartment rented by person A. Person B can pay the amount needed to rent an apartment with a transaction entered in the blockchain. Thus, he received a digital account which is contained in a virtual agreement between the two parties. Person A then sends person B a digital key that will be available to person B from the agreed date. If B does not receive the key on time, the code containing the smart contract automatically returns the paid funds. If A sends the key too early, the function within the program keeps it until the date the rental is agreed. Along with the key, the function also stores the cryptocurrency fee paid to person A when person B receives the key. The code is written in a blockchain that maintains thousands of partners in the system and B does not have to worry about an error or fraud. Also, person A can be sure that his rental service will be paid if he sends the key. The contract is automatically terminated after the agreed time, and the code cannot be changed by any participant without the knowledge of another, all participants will be notified of changes at the same time.

Blockchain is a set of contemporary technologies that in synergy create a network that ensures trust among users. Blockchain is a decentralized and distributed database in which data cannot be changed or deleted and which enables the verification of transactions (Misic & Mrazovac, 2020). Three basic parts can be singled out: block, chain and network. It is based on distributed general ledger (DLT) technology to store cryptographically

verified user group data, as agreed in a predefined network protocol. Cryptographic techniques enable encryption of all important data records in the blockchain, important for consistent data and record integrity.

A block is a list of transactions recorded in a book/register over a period of time. Transaction data is stored on various computers on the network, which are connected using the peer-to-peer protocol. This registry can be thought of as a record book that notes and stores all transactions between participants chronologically, and all online users, called nodes, have an identical copy of the book. Also, each node shares the same copy of the data, i.e. digital register (Digital Ledger). The network consists of "full nodes". Each node includes a complete record of all transactions that have ever been noted in that blockchain. The function of nodes is to continuously check the authenticity of records in the chain, and in the case of verification fail, to reject the proposed data blocks. Therefore, this approach to data storage is considered far safer than centralized databases.

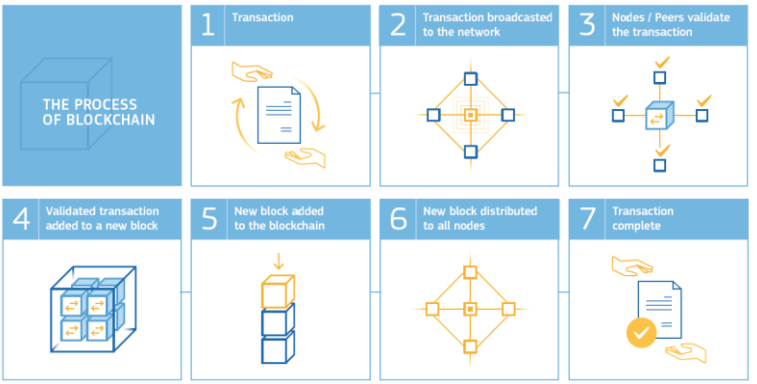
The approach of selecting an initially valid block of transactions is called proof-of-work (Hileman & Rauchs, 2017) and practically protects the network from misuse. In the end, the validated block gets its own unique timestamp and signature (hash), and as such is propagated to other nodes in the network. When adding each subsequent validated block, the certificate counter for the previously entered blocks is incremented, and the probability that they are false is further reduced. Over time, the reliability of recorded data increases.

Changing data in blockchain is done according to predefined rules. Changes are passed to all nodes to update the local copy of the data. Once a transaction has been saved and validated by all nodes in the network, it is no longer possible to change the data of that transaction, or it is difficult to change it. The process of validating these transactions is called mining and is based on one of the consensus algorithms on the basis of which an agreement is reached between the nodes when adopting a new block (Misic & Mrazovac, 2020). After confirmation, there is a connection with other transactions in the new block which is joined to the blockchain. Procedure ensures that each block is formed as that the previous and the next are irrefutably connected, thus forming a chain of blocks or a blockchain. A chain is a hash that connecting blocks, or mathematically "chaining". A hash is formed from the previously existing data in the block. A hash can be viewed as a fingerprint of data that locks into blocks according to order and time. The hash forms a one-way function and it cannot be decrypted,

while the hash function creates a algorithm to map data of any size to a series of fixed-size bits.

Blockchain consists of three layers: protocol, network and an application or business layer. Each layer adds different components to the blockchain in order to develop it (Figure 1).

Figure 1: *The Blockchain process*



Source: *European Union (2019). Blockchain now and tomorrow. Assessing multidimensional impacts of distributed ledger technologies. Luxembourg: Publications Office of the European Union*

Figure 2: *Blockchain types*

	Type	Description	Example
Open	Public without permission	Anyone can participate in the consensus mechanism. Also, all users can perform transactions and view the entire transaction log.	Bitcoin, Litecoin, Ethereum Figure 3. a)
	Public permissioned	Users receive permission to execute and view transactions, but only a limited number of nodes participates in the consensus mechanism.	Ripple, private ver. Ethereum Figure 3. b)
Closed	Private permissioned	The restriction applies to permissions to perform and review transactions only on nodes participating in the system, while the system owner determines the participants and nodes that may participate in the consensus mechanism.	Rubix, Hyperledger Figure 3. c)
	Private without permission	The restriction applies to permits to conduct and review transactions, while the consensus mechanism is open to all.	(Partially) Exonum Figure 3 d)

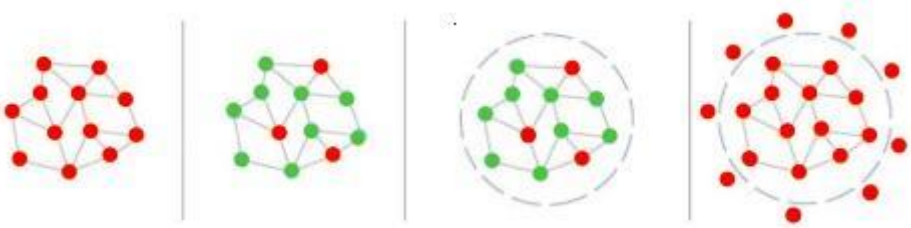
Source: *Authors, adapted from OECD, Blockchain Primer, www.oecd.org/finance/blockchain/ (3 August 2021)*

There are a large number of blockchain networks with different functionality and architecture. They differ depending on who can read, execute and confirm transactions. Although "there are a number of different characteristics, the two most important are the "openness" of the platform (public or private) and the level of permission required to add information to the blockchain (with or without permission)" (Europen Union, 2019).

A public blockchain network (like Bitcoin) is open and anyone can access the entire blockchain, while when only an authorized entity has access, the blockchain network is private or closed. Similarly, a permissioned blockchain network allows only a selected group of users to write, i.e. transaction generation and execution, i.e. verifying the new block. In contrast, an unlicensed blockchain network allows all users to contribute and add data to a book.

Red dots represent validation nodes, i.e. they verified transaction in the process and participate in the consensus process. Green dots indicate participants who can perform transactions, but are not able to participate in the confirmation process. Nodes in the circle can see transaction history. Illustrations without a circle indicate an open network, i.e. that all users can see the history of transactions.

Figure 3 a, b, c, d: *Examples of Blockchain*



Source: *Authors, adapted from European Union (2019). Blockchain now and tomorrow. Assessing multidimensional impacts of distributed ledger technologies. Luxembourg: Publications Office of the European Union*

There are other divisions of blockchain networks, into public, private and consortium (Hileman & Rauchs, 2017), where the consortium is a type of blockchain where the consensus process is controlled by a pre-selected set of nodes. The authors (Danezis & Meiklejohn, 2017) also listed different types of hybrid networks.

The advantages provided by the application of blockchain technology in different domains is a combination of key features: decentralization, immutability, transparency and security.

1. Decentralization
As mentioned earlier no central entity controls the process affects the strong flexibility of the blockchain. Multiple and distributed nodes that are hard to attack at the same time, i.e. to destroy the entire network, also contribute to this. However, in the research (Gencer et al., 2018), the authors pointed out some doubt about decentralization, for example large-scale basins where mining activities are conducted.

2. Resistance to abuse / immutability
Every modification in the blockchain is noticeable to everyone, so it is almost not possible to make changes imperceptibly. Public-private keys or cryptographic signatures also ensure integrity and authentication (Europen Union, 2019). The blockchain transaction system is based on public and private key pairs generated around a particular encryption algorithm. Blockchain technology prevents abuse in terms of falsification and denial of content because it keeps complete records in blocks of data in a timestamp, where old and new blocks of data cannot be deleted, and a cryptographic algorithm prevents unauthorized falsification and reduces the possibility of fraud (Sun et al., 2018).

3. Transparency
A book is available to all users or a predefined set of users. However, transparent data in a public system can be an issue when some information should not have been made publicly available or need to be changed due to errors, inaccuracies or other data entry issues (Finck, 2018). This is at the moment one of the most contentious problems - the still unresolved compromise among transparency and privacy in public or open blocks.

4. Security
A high level of security is provided in the blockchain, because the transactions that take place are anonymous. Any transaction or digital event that takes place in a blockchain network is verified only if it is agreed by the consensus of the majority of users participating in this process (Chatterjee & Chatterjee, 2017).

Interview with students

For the purpose of this study 15 subjects were interviewed. Subjects were students coming from different high educational institutions (HEIs) in Serbia that are not technically oriented. HEIs were both public and private. Students were from different level of study, different age and gender.

The topic of the interview was how much students are familiar with blockchain technology and about their experience in using it. It was assumed that students are not very familiar with those technologies, so it was decided to use the interview method instead of a questionnaire. In that way, the possibility to get more useful information from student's answers is increased.

The interview was conducted from basic questions about appliance of blockchain technology in well-known industry sectors, companies, real life, investments etc. The interview was first conducted with the students individually. After that, the online meeting of all students was organized where they exchanged opinions with each other and discussed questions and answers from the previous interview.

In the introductory part of the interview, students were asked about I4.0 technologies and connected technologies. Also, they have been asked whether they have met application that use mention technologies in real life and/or during their previous education at HEIs.

It is interesting that all students have been informed about new technologies with underlined connection with their specializations at the HEIs through their previous education and various subjects. Students were unsure of whether they had encountered new technologies in real life. For example, students were using E-Government, together with electronic identity, electronic signature and electronic payment.

The first group of questions was aimed at determining students' knowledge of the blockchain technologies, their level of information about these technologies and whether students have encountered these technologies so far. The questions were selected from the known to the less known and as a preparation for another group of questions. Research questions were as follows:

Question1: Have you heard of Bitcoin and had any personal experience with any cryptocurrency?
Question 2: Do you know what technology cryptocurrency is based on? Have you heard about blockchain?
Question 3: Did you meet blockchain technology in real life (except cryptocurrency)?

All students have heard about cryptocurrencies. One of the students was on a specialized course for cryptocurrencies usage, which was held outside of regular education at the HEI, i.e. cryptocurrency mining company course. Only 6 students presented knowledge to connect cryptocurrency with blockchain technology.

Before the second group of questions, students were introduced through a short presentation on the application of blockchain technology in the food industry and tourism with the main characteristics of blockchain technology. These examples were chosen with the assumption that on these examples, which are easy to understand, students will better understand the presented information.

It is interesting to note that some students mentioned the example of the application of blockchain technology in the food industry in Serbia. The example referred to one coffee brand. They learned about it from the coffee wrapper that appeared in 2021. The cover contained a QR code through which the coffee production of this brand could be tracked.

During the discussion, students concluded that blockchain technology has potential for many different areas of the hospitality and travel industry. Usage of blockchain technologies in tracking luggage, identifying passengers, ensuring secure traceable payments and enabling customer loyalty programs to run better was discussed. They also agreed that it could have a massive impact on the travel industry in upcoming years. During the discussion, they all agreed that financial transactions are a key element of the travel industry. According to this, blockchain technology could simplify payments and make them more secure and traceable.

Research questions regarding the application of blockchain in education were as follows:

Question 4: Have you ever met the application of blockchain technology in education?

Question 5: In your opinion, can this technology be implemented at the HEIs to monitor student progress and reputation through education and future training?
Question 6: Do you know that internal cryptocurrency can be used in applications that use blockchain technology in education? Do you believe that applying internal cryptocurrency in applications could improve educational process?
Question 7: Do you believe that blockchain technology is safe and would you use it while studying through certain applications?

Only 3 students had heard that such technology could be used in education. After this issue, the discussion went in the direction of applying internal cryptocurrency in education. None of the students had any experience with that. It was explained that the application of internal cryptocurrency in education could be useful for students, professors and future employers. 13 out of 15 students agreed that such a thing could be interesting and could improve the educational process. 2 students expressed doubts about this type of application of cryptocurrency for educational purposes.

All students who heard about blockchain technologies were also informed about the safety of this type of technology. They expressed the opinion that they would be confident in the application of applications that use this type of technology. In a later discussion among the students, it was concluded that this opinion stems from the original idea, which is that blockchain technology is linked to cryptocurrency.

The last question was as follows:
Question 9: Do you think a large number of leading companies use blockchain technology?

14 out of 15 students answered in the affirmative to this question, while 1 student expressed doubt. They didn't know which companies are using blockchain technology.

Proposed Model

Participants in the proposed model (Figure 4) are lecturers, students of tourism and tourist professionals. Lecturers from the higher-education institution (faculty) assigning tasks in the form of the project relevant subjects to students. Each project working team of students. The number of

students in a team depends on the complexity of the project and this is determined by the lecturer, as well as the approval of the project topic.

Tourism professionals are of great importance when choosing a topic, because their advice and storytelling can point to current topics, but also the shortcomings of the proposed solutions. The professional has a motive to participate in the proposed process because in that way he/she is "at source" in the selection of his future staff.

Figure 4: *Proposed model using blockchain*

Source: *Authors*

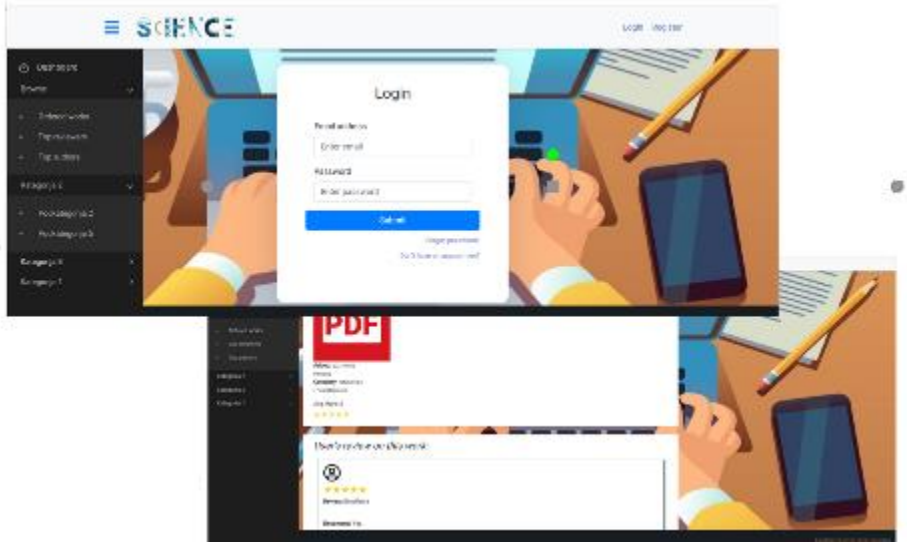
In order to improve the efficiency and quality of projects, the approach proposed in this paper assumes that older students and tourism professionals have an active role in the analysis of student projects. In addition, it is the obligation of each student to analyze a minimum of 2 projects (obligation for course students). In this way, students' collaborative learning occurs. Collaborative learning includes five intertwined components (Shonfeld & Gibson, 2018):

1. positive interdependence;
2. personal responsibility;
3. promoting interactions;
4. social skills; and
5. group process.

The analysis form is prescribed by a teacher and is available to all participants and is an integral part of student education, part of the acquisition of new knowledge and pre-exam obligations.

In the first level of the proposed model each participating member in the system is previously configured as a valid peer from a specific higher-education institution (or company) with a proven identity. Participants must comply with agreement and ethical standards. In this way, the requirement for data protection regulations is met. Experimental platform for this level is buildup (Fig. 5).

Figure 5: *The first level of the proposed model*



Source: *Authors*

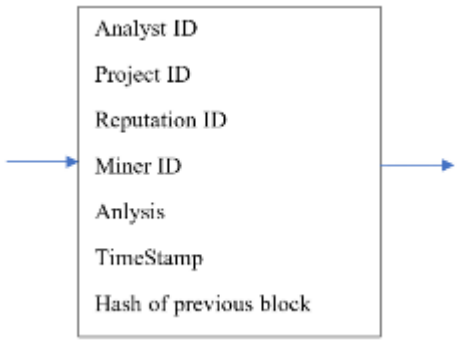
Project topics follow the content of the course and can be selected by the student team and approved by the professor or assigned by the professor with prior consultation and discussion with students and selected according to their interests and preferences. Some of the topics that students expressed interest in the interview are: Social media data analysis, clustering, 3D presentation, using drones in video presentations, mobile application, education through gaming, etc.

After the completion of the project, the Analysis form is filled in, which consensus is made and the assets in the ledger are updated. Via the part of the consensus algorithm, the teacher and the student have their own copy of the ledger and the uploaded smart contracts, so that the approval procedure is actually the execution of smart contracts and sending the out-come results further in the network to check the veracity and reach a consensus (Second Level). This level is transactions level. Matching the

analyst and the subject matter of analyses, are performed in the BC form database. If there is no consensus, the student will lose their reputation.

The form database is managed autonomously and uses a distributed server of timestamp on a peer-to-peer network. The BC for the analysis of students' projects is shown as a sequence of the form blocks.

Figure 6: *The blockchain for the analysis of students' projects*



Source: *Authors*

Proposed scheme:

1. The Form blockchain: it is a growing list of form analysis blocks.
2. The Analyst: teacher, student, person from practice. Analyst is not publicly known, but only to those who have appropriate privileges (e.g. professors).
3. The key infrastructure (KI): procedures for the key encryption.
4. The database of forms. Recorded and neither side can deny or change forms.
5. Miners.

The blockchain-based scheme for analyses designed as above is resistant to data modification.

Conclusion and Discussion

Students are generally interested in gaining knowledge in their area of interest related to new technologies. Therefore, it is primarily necessary to continuously educate teachers and regularly update the content of the subject in order to follow modern trends. This requires teachers' professional development and shift in their attitudes and integration of

multidisciplinary approach. Lack of funds for this activates is the main problem in many HEIs.

The model has a dual function in relation to blockchain technology: BC-based, evaluation of student projects on current topics related to tourism and new technologies via blockchain, where teamwork and collaborative student learning are performed, together with the implemented part of dual education, which includes companies from the sector tourism in the educational process. At this stage of the development of the proposed model, on the first level, teachers report on more efficient work and faster successful completion of project tasks. The results of the experimental phase of the model development will be presented in the authors' future work. Experimental part of the project is a precondition for further implementation of the model according to the project task.

One of the obstacles to the faster introduction of these technologies is the slow adoption of regulatory policies in many countries, which slows down their implementation in many areas. The Law on Digital Property came into force at the end of 2020 in Serbia. It is important to mention the active role of the state in implementing these technologies in the educational process, especially their wider use. Blockchain technology brings a number of innovations concerning security, transparency, data privacy and their indisputability. On the other hand, the industry in all areas is increasingly paying attention to the skills of its employees in order to keep pace with the requirements for technological services. Also, the need for cooperation between the industry and HEIs is increasingly expressed.

This research has some limitations. Fifteen students coming from HEIs in Serbia were interviewed. Only one of these students was from the Department of Tourism. However, all interviewed students are from the social sciences field, not technical oriented fields. Thus the authors believe that selection of students is appropriate for this research, especially bearing in mind that the model can be easily adapted to the students and research of other profiles. Another limiting factor is the students' poor knowledge on blockchain technology and its main characteristics. Therefore, the authors paid special attention to bringing these technologies closer to readers, especially those from the tourism sector. In addition, it is one of the prerequisites for the successful inclusion of these technologies in the educational process, both through the proposed model and through the subject that addresses the application of BCT in tourism.

BCT are increasingly present in all areas of life and work, while blockchain technology popularity has been primarily achieved due to cryptocurrencies and tokens. The paper gives examples of successful implementations of blockchain technology in the tourism sector. Several years ago, prestigious universities around the world have implemented BCT in their educational processes, which will certainly encourage other HEIs to consider the introduction of these technologies in their educational processes, both through the study of these technologies and their use.

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