***BoostEdU IO 2 Report***

**Blockchain-based educational certificates.**

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Bucharest 2022

Contents

[1. Introduction: Blockchain-based educational certificates, present and future. Fake diploma problems 4](#_Toc134556383)

[1.1. What is Blockchain? How does it work? 4](#_Toc134556384)

[1.2. The importance of Blockchain 5](#_Toc134556385)

[1.3. Types of Blockchain 6](#_Toc134556386)

[1.4. Applications of Blockchain 7](#_Toc134556387)

[1.5. Advantages and disadvantages of using blockchain. 9](#_Toc134556388)

[1.6. Educational Sector 10](#_Toc134556389)

[1.6.1. Blockchain Technology for Educational sector 10](#_Toc134556390)

[1.6.2. Blockchain-based educational certificates. Challenges reduced by blockchain. Fake diploma problems 11](#_Toc134556391)

[1.6.3. The advantages of Using Blockchain in an Educational Environment 12](#_Toc134556392)

[1.7. Students Certificates verification 12](#_Toc134556393)

[2. Analysis of the status quo of Digital Education Recognition 14](#_Toc134556394)

[2.1. Analysis of current state-of-the-art of European Digital Education Recognition using blockchain in comparison to best practices in the world 14](#_Toc134556395)

[2.1.1. Results of Case Studies on the Application of Blockchain Technology in Education 15](#_Toc134556396)

[2.2. Analysis of Digital Education Recognition in Romania 16](#_Toc134556397)

[3. Methodology for collecting data 18](#_Toc134556398)

[3.1. Objectives of the study 18](#_Toc134556399)

[3.2. Development of hypothesis vs questionnaires/interviews 19](#_Toc134556400)

[3.2.1. Questionnaires (for students). Justification 19](#_Toc134556401)

[3.2.2. Interviews (for experts). Justification 20](#_Toc134556402)

[4. Analysis of data in Romania 21](#_Toc134556403)

[4.1. Centralization of data 21](#_Toc134556404)

[4.1.1. Questionnaires (for students) 21](#_Toc134556405)

[4.1.2. Interviews (for experts) 52](#_Toc134556406)

[4.2. Statistical and logical analysis 55](#_Toc134556407)

[4.3. Synthesis of results vs hypothesis 122](#_Toc134556408)

[5. Digital Recognition – Uses of Blockchain in Czech Higher Education 125](#_Toc134556409)

[5.1. Introduction 125](#_Toc134556410)

[5.2. Research Methodology and Sampling 128](#_Toc134556411)

[5.3. Results and Discussion 128](#_Toc134556412)

[5.3. Conclusion 132](#_Toc134556413)

[6. Digital Recognition – Uses of Blockchain in Norway 133](#_Toc134556414)

[6.1. Introduction 133](#_Toc134556415)

[6.2. The challenge 134](#_Toc134556416)

[6.3. Summary comment 135](#_Toc134556417)

[7. Digital Recognition – Uses of Blockchain in Iceland 135](#_Toc134556418)

[7.1 Introduction 135](#_Toc134556419)

[7.2. History of Blockchain 135](#_Toc134556420)

[7.3. A potential application of blockchains, being developed at Bifröst University. 136](#_Toc134556421)

[7.4. Final thoughts and conclusion 138](#_Toc134556422)

[8. Development of a pilot model using blockchain concept for “record keeping” of student’ degrees, certificates and diplomas based on the previous analysis. Simulation of a case study 138](#_Toc134556423)

[9. Conclusions: a common framework of a European Digital Education Recognition solution 140](#_Toc134556424)

[References 141](#_Toc134556425)

# 1. Introduction: Blockchain-based educational certificates, present and future. Fake diploma problems

## 1.1. What is Blockchain? How does it work?

As it is written in [1], in 2008, Blockchain was introduced as a new technology. It began as a peer-to-peer database for recording Bitcoin cryptocurrency transactions.[2] The main objective, as it is said in [3], was to reduce any intermediaries and to allow clients to access their business directly, this is why Blockchain was created as a decentralized network of peer nodes.

Each entity:

* can have copy of the ledger of transactions;
* when it obtains agreement from the others in the network, it can create an item to its own repository;
* can verify that the ledger it possesses is identical to those throughout the network on a regular basis;
* broadcasts to the rest of the network any transaction made by its users.

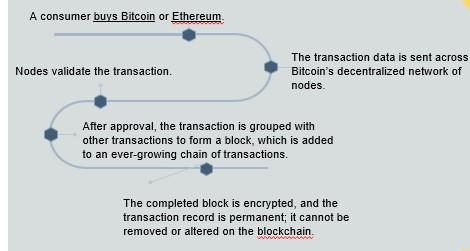
The Blockchain is a distributed database or public ledger that stores a list of all digital events or transactions that have occurred and is fundamentally shared among all participants. Only if the majority of the participating parties decide, a transaction can be valid. Moreover, it is impossible to remove or change data unless with the agreement of all or the majority of the network participants, once it has been confirmed and inputted, exactly as it is said in [7], ―an analogy in non-technical terms; it is very easy for anyone to steal a cookie from a cookie jar that is kept in a hidden place than to steal from a jar that is placed in a market place, where thousands of people are keeping an eye on‖.

*How does it work?*

The name Blockchain is not by chance: A "chain" of separate "blocks" of data is often used to characterize the digital ledger. A new "block" is formed and attached to the "chain" as new data is uploaded to the network. This requires that all nodes update their Blockchain ledgers in order to be identical.

Why Blockchain is considered highly safe is due to how these new blocks are formed. Before a new block can be added to the ledger, a majority of nodes must check and certify the legitimacy of the new data. An independent database or spreadsheet, on the other hand, allows one individual to make changes without oversight.[8]

Figure 1.1 shows an example of how Blockchain is used to verify and record Bitcoin transactions:



**Figure 1.1: An example of how Blockchain is used to verify and record Bitcoin transactions**

## 1.2. The importance of Blockchain

Blockchain has several qualities that make it useful. The success of Bitcoin, whose capital market presently stands at 191 billion USD [9], demonstrated the robustness and promising aspects of blockchain. Blockchain, according to the UK government's office of research, secures data records, lowers operational expenses, and increases transaction transparency.

The following are some of the interesting aspects, benefits, and significance of Blockchain, as it is mentioned in the [10]:

* **Networked existence:** At the same moment, different users (nodes) on the Blockchain network store the same Blockchain data. Even if one node fails or loses data, other nodes in the network have a copy of the Blockchain and can continue to update it. The Blockchain can be recopied from other nodes. This feature guards against data loss, record tampering, and cryptocurrency costs unnecessary.
* **Decentralized nature:** Blockchain's decentralized nature eliminates the need for central authority and middlemen, making it more ideal for applications. Blockchain enables systems to be self-contained and devoid of the hazards that come with relying on middlemen and central authorities. Private Blockchains, on the other hand, can be partially or totally centralized while still benefiting from the other Blockchain features.
* **Data security and integrity:** Blockchain is secure in the sense that any changes to data in any block are discovered by a change in the block hash, which differs from the previously recorded hash in the next block. To be successful, a malicious user must change the block data for all computers on the network, which is essentially impossible in a large network. As a result, data on Blockchain is protected against alteration in this regard.
* **Traceability and transparency:** Because Blockchain records are time-stamped and saved on all complete nodes on the network, everyone can check and see all activity and transactions. All of a node's activity and transactions can be tracked if its address.

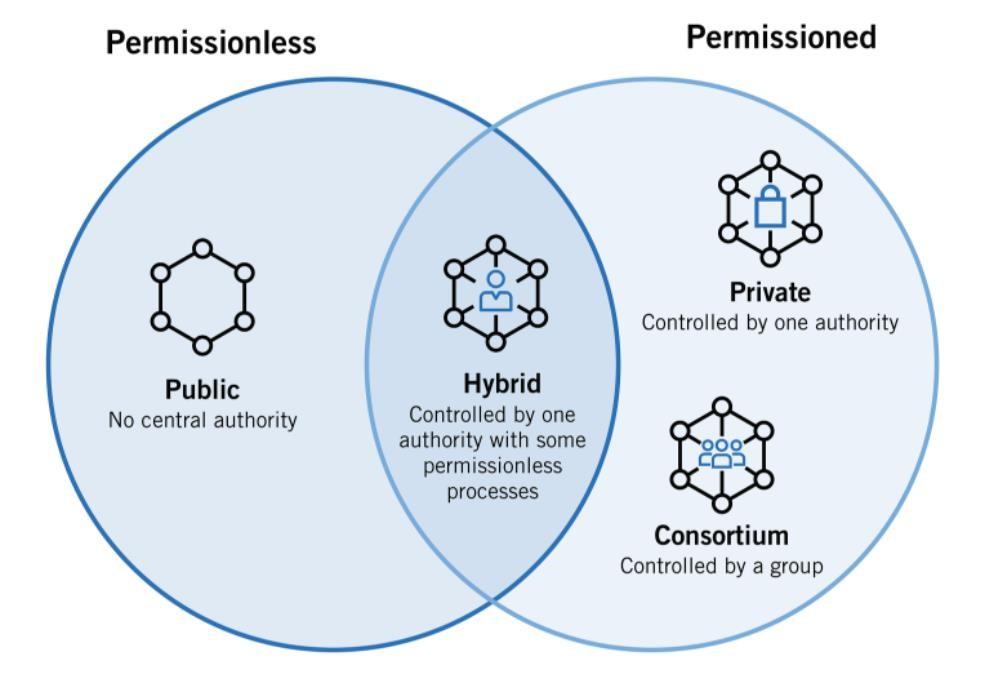
is known. Blockchain becomes visible and traceable because of this. It's also a useful platform for auditing and public services because it's suitable for fraud detection.

* **Efficiency:** Because middleman subsystems are removed, Blockchain allows systems to work autonomously with greater efficiency. This is one of the advantages that many companies and countries are hoping to obtain from Blockchain technology.
* **Verifiability:** The legitimacy of a record may be checked thanks to Blockchain's encryption. This may be difficult to do in other databases since it necessitates cryptographic technologies such as Blockchain's digital signature.
* **Interoperability**: Blockchain provides a secure data sharing platform that allows separate parties to share the same data and synchronize their services.
* **Cost savings:** Using Blockchain saves a lot of money because it eliminates the need for intermediary systems. Banks might save $20 billion each year if they used efficient Blockchain. One of the reasons why some banks and businesses seek to integrate Blockchain into their systems in order to save money is because of this economy.

Border control, government identity, insurance, shipping, real estate, advertising, waste management, energy, tourism, and a variety of other problems can all be solved with Blockchain technology. It is made up of numerous algorithms that are kept in the ledger and are used to detect faults. It also determines which block the error happened in.

## 1.3. Types of Blockchain

Due to the wide range of interests in Blockchain applications, the technology is divided into four categories: public, private, hybrid and consortium Blockchains as it can be seen in the following figure.



**Figure 1.2: Types of Blockchain [11]**

For a better view about this four categories of blockchain, in the table there are the advantages, disadvantages and some use cases of each one:

**Table 1.1: Differences between types of Blockchain [12]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Public** | **Hybrid** | **Consortium** | **Private** |
| **Describe** | No central authority | Controlled by authority with some  permissionless processes | Controlled by a group | Controlled by one authority |
| **Advantages** | Transparency  Independence  Trust | Acces control  Performance  Scalability | Acces control  Scalability  Security | Acces control Perfomance |
| **Disadvantages** | Performance  Scalability  Security | Transparency Upgrading | Transparency | Trust  Auditabilitry |
| **Use case** | Document  validation  Cryptocurrency | Medical records Real estate | Bancking  Research  Supply chain | Supply chain Asset ownership |

## 1.4. Applications of Blockchain

Blockchain was originally employed in cryptocurrencies, with Bitcoin being the first to demonstrate its success. There are numerous Blockchain applications today, as summarized in the following figure:



**Figure 1.3: Blockchain applications tree [13]**

To be more specific, in the following it will be explaining a little bit the importance of the use of Blockchain in the most important domains [13]:

####  Cryptocurrencies

* **Smart contract:** Smart contracts are utilized on the Blockchain to deliver a variety of services to corporations, governments, organizations, and the public, including financial, medical, games, wallet, voting, libraries, and other services.
* **Healthcare management:** Data inconsistency, duplicate information, and patients' inability to recognize and control their own records are all problems with the present healthcare management system. When implemented correctly, Blockchain has the potential to alleviate these healthcare issues. Blockchain is now being used in the healthcare industry to share and secure data. The documents are stored on the Blockchain for the purposes of sharing, accessibility, security, cost reduction, and traceability.
* **Insurance:** Insurance businesses are increasingly utilizing Blockchain technology. Putting insurance data on the Blockchain prevents fraud while also allowing data sharing and interoperability across insurers.
* **Banking and finance:** Blockchain have the potential to disrupt the banking and finance industries. Many banks have been experimenting with Blockchain to improve their systems. Blockchain is used to power a variety of services, including online payments and digital assets.
* **IoT industry:** Because IoT devices must be autonomous, communicate, and share data without human intervention, blockchain has gained interest for use in IoT.
* **Decentralized data storage:** The benefits of Blockchain storage include speed, security, flexibility, and low cost.
* **Intellectual properties and document stamping:** Blockchain is used to support intellectual property and document stamping, which helps to prevent document forgery. After being stamped and digitally signed, documents are stored on Blockchain. Because anyone can access the certified document on Blockchain for validation, crafting such documents becomes more difficult and time-consuming.
* **Digital identity management:** Identity management is one of the more recent and effective Blockchain uses that several governments and companies are considering. Individuals have traditionally been issued identification by government authorities and organizations in the form of passports, ID cards, certificates, and other documents. Traditional identity management is extremely vulnerable to theft, fraud, and loss. With the introduction of Blockchain, identities may now be managed safely and autonomously without the need for central authorities.
* **Project management:** Standard contract management is inefficient, entails a high level of risk, and results in higher operational expenses. Many businesses now offer Blockchain-based contract management solutions and platforms. Companies and their clients utilize the platforms to easily track and manage their contracts.
* **Cybersecurity:** Blockchain technology is being used to improve cybersecurity. To provide secure and permanent records against attackers, network history, configuration, log files, and other network data are saved on Blockchain.
* **Asset registry and tokenization:** Tokens can also be used to represent assets, which can then be traded or kept on the Blockchain. To eliminate fraud and asset theft, asset registries can easily be managed on Blockchain in a safe manner. Asset tokenization, land registry, property marketplaces, and standardization of property data are all possible with Blockchain.

## 1.5. Advantages and disadvantages of using blockchain.

According to [14], Blockchain technology has been portrayed as a disruptive technology that provides unprecedented levels of security, which is required and wanted not only by the IT and finance industries, but by all industries in general, making it a very adaptable technology.

Despite its many advantages, Blockchain technology is far from flawless, and it has advantages and problems in its deployment, much like every revolutionary technology.

**Advantages:**

* Higher accuracy of Transactions
* No need for intermediaries
* Extra security
* Efficient transfers
* Decentralization
* Network distribution
* Resistant and resilient **Disadvantages:**
* Limit on Transactions per Second
* High energy costs
* Potential for illegal activity
* Risk of asset loss
* Private keys
* Unemployment
* Storage

And there are also some characteristics of the Blockchain network that can be both an advantage and a disadvantage, like:

* Immutability of information.
* Anonymity

## 1.6. Educational Sector

The education sector is undergoing technological transition; yet, there are numerous challenges with this. Virtual classrooms are taking over from traditional classrooms. The real question is how might blockchain technology help educational institutions and students’ study more effectively?[15]

This topic can be answered in a variety of ways; however I'll focus on three major segments to describe the advantages of blockchain solutions and for whom it is beneficial:

* Educational institutions (e.g., universities, start-ups, and non-governmental organizations) that are searching for solutions to improve the efficiency and security of student data storage and management;
* Learners who would benefit from more interesting, dependable, and long-term methods of accumulating, attesting, and sharing information;
* Employers who want to assess the validity of students' talents and credentials in a trustworthy and secure manner.[15]

It's worth emphasizing that the application of blockchain in academia is still in its early stages, which has an impact on the availability and quality of research on the subject. The majority of existing solutions employ blockchain as a secure system for validating and distributing personal student data and academic diplomas, along with educational organizations' databases.

### 1.6.1. Blockchain Technology for Educational sector

After some research, it is clearly to say the best way to explain how blockchain could be implemented in educational sector is to divide the interests, the same as it is explained in: [15]

* *Enhancing security and efficiency for educational institutions, corporations, and students:*

Blockchain technology has the potential to protect students' data by ensuring their identification, privacy, and security. As previously stated, blockchain ensures integrity through its hash chain, which provides security and authenticity. Students, for example, cannot change past educational certifications stored on the blockchain. Furthermore, because blockchain does not store data, but rather a hash of it, privacy is assured. Before being stored on the blockchain, the data might be encrypted if desired.

As it is mentioned in [16], a variety of blockchain-powered efficiency applications, including record-keeping applications like digital credentials and intellectual properties, simplifying diploma verification, and fast and reliable student payments. Not only do these technologies save money and time for educational institutions, but they also save time and money for companies and individual students.

* *Integrating trust and transparency*

Employers may be assured that job applicants have the required abilities to succeed in the industry since blockchain guarantees that students cannot falsify their grades, degrees, or certifications. *B*lockchain becomes a ―trust anchor of one truth for credentials‖ as it is said in an research „Tapscott and Kaplan, 2019‖.

Moreover, this anchor gives job searchers and companies the option to make better matches. In general, because distributed ledger technologies enable learning and protect academic records, they improve interactions between "universities, companies, companies, and their relationships to society" by integrating trust and transparency into skill transactions and sharing procedures.

* *Learners' empowerment (self-sovereignty)*

The data (e.g., credentials, skills taught, etc.) linked with a student's identification is owned by the student, not by a central administration like a university. Students can keep their lifetime learning data (both inside and outside of the classroom), fully own it, and decide who has access to it.

Furthermore, even when students benefit from blockchain "wallets" where they can store and share all of their learning data with various parties (students being complete owners of their identity-related data), they still benefit from the support of their professors, ensuring that they are not alone in their learning journeys.

Blockchain can facilitate most important element for educational institutes, as:

* Decentralization;
* Immutability;
* Smart contracts;
* Payment registry;  Security;  Transparency.

### 1.6.2. Blockchain-based educational certificates. Challenges reduced by blockchain. Fake diploma problems

Students' educational qualifications become public and simply shareable with companies and universities for opportunities for future personal growth. Employers can base on reliable, realistic representations of students' potential based on academic accomplishment thanks to Blockchain, which provides students with an empowering tool to manage and share their learning achievement (trusted verification).

The following are some of the challenges that blockchain can alleviate:

* It has the ability to establish an environment in which students' personal databases can be modified and subsequently stored. The blockchain gives institutions access to data, which is lot more precise, and any changes don't have to be as time-consuming;
* It can be seen in the development of an open-source environment. This can provide a place to store all of the documents that a student will need during his or her course of study, as well as provide an air of validity for students to carry less documents in their luggage, so offering an alternate mode of education;
* One key benefit of this technology to the educational backdrop is that it provides each student with a unique id, which aids students in matching up their information, and in the event of any project confusion between two students, it can be readily resolved. The ability to see the grades in real time can be a huge benefit;
* The issue that the schools/universities face is the high number of incidences of fraud and fraudulent diplomas offered to pupils. The fundamental objective of blockchain technology is to get to a point where every block is a proven block, so that if there is any fraud, the necessary information is sent directly to the higher authorities, who may take swift action.

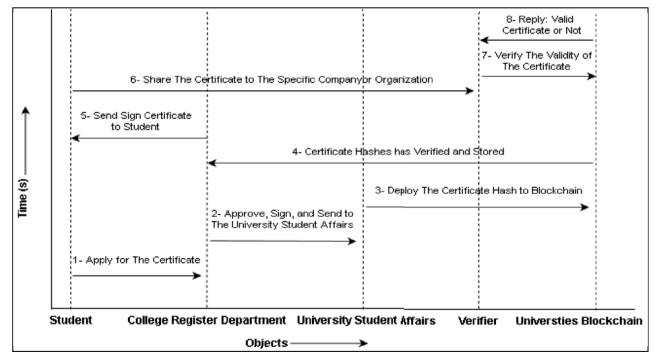
### 1.6.3. The advantages of Using Blockchain in an Educational Environment

As it is mentioned in [7**Eroare! Fără sursă de referință.**], the main advantages of using Blockchain in an Educational Environment are:

* It gives its customers the opportunity to check the veracity of a record against the Blockchain without involving the issuing organization.
* It works to eliminate the practice of issuing certifications on paper. Educational establishments' qualifications can be reliably and permanently recorded via Blockchain. Further developments could include automating certifications, transferring credits, or even preserving a complete record of a student's accomplishments throughout their academic career.
* Implementing Blockchain technology can drastically cut the costs incurred by educational institutions in maintaining data. It also enables for the reduction of liability risks that are common while handling records.
* The records are open to the public and easily verified.  Enhancing learners interactivity.
* Supporting learners’ career decisions.
* Improving the management of students’ records.  Enhancing trust.
* Identity authentication
* Enhancing accountability and transparency
* Better control of data access
* Enhancing students’ assessments  High security.

## 1.7. Students Certificates verification

As it is explained in [17], below i will narrate the method of using Blockchain to ensure the validity of students’ certificates.



**Figure 1.4: Proposed Model WorkFLow [17]**

„The first step of the planned model work begins with the department's examination committee submitting the graduating student's grades to the university's suggested central system. After this procedure is completed, the system sends the results to the dean of the faculty, the person in charge, or the person with power, in one of two scenarios. Returning the conclusions to the examination committee for change within the terms and conditions is the first case.

The system then hashes each signed student's certificate and sends the hashes to the college's registration department. An identical version of these certificates is also given to the university's student relations department. The hash function returns a string with a specific length, which is the hash value. The suggested model extracts the hash value for each student's certificate separately, which is used as a certificate verification checksum.

After the verification processes by participants entities are completed, the hash function was proposed to achieve a one-way encrypted and compressed record of the students' certifications, which were then deposited on the blockchain. The it is restricted the process of issuing a certificate by employing the given strategies above in the proposed model. Furthermore, non-participants of blockchain networks, such as other firms and organizations, will be able to confirm the validity of the student's certificate that is delivered to them in a secure and rapid manner.

Any graduated student from any of the member colleges in this system can request a graduation certificate from anywhere in the world at any time under the proposed method. It provides an Internet-based portal or application that enables students to request an addressed certificate to the appropriate destination in accordance with the requirements. When utilizing the portal, the student must provide crucial details such as their complete name, college, department, and the address to which the certificate will be sent, as well as a valid email account.

As the benefit of using the proposed model, the Validations of Certificates phase is considered the system's practical and actual result. The actual work of this phase begins when an institution or a corporation wants to verify the legitimacy of the certifications presented to them in order to be considered for an advertised post. When a graduate student submits his or her higher credential information in order to be considered for a specific position inside a corporation (get hire). As a result, the organisation must ask the concerned person to check the legitimacy of the presented certificate. In this instance, the company's employer can use a system-supplied portal to verify the authenticity of the provided certificate in a real, accurate, and secure manner. ‖

# 2. Analysis of the status quo of Digital Education Recognition

## 2.1. Analysis of current state-of-the-art of European Digital Education Recognition using blockchain in comparison to best practices in the world

As it is said in [18], the European Blockchain Partnership (EBP) was established after EU member states and Norway signed a declaration with the goal of providing digital public services that meet the requisite degree of digital security and maturity in today's society.

―In the future, all public services will use blockchain technology. Blockchain is a great opportunity for Europe and member states to rethink their information systems, to promote user trust and the protection of personal data, to help create new business opportunities and to establish new areas of leadership, benefiting citizens, public services and companies. The Partnership launched today enables member states to work together with the European Commission to turn the enormous potential of blockchain technology into better services for citizens‖ declared Mariya Gabriel, the commissioner for Digital Economy and Society, in 2018.

Many industries and colleges in Europe and beyond are becoming increasingly interested in blockchain technology. Blockchain, a relatively new discovery in computer science, is a worldwide, cross-industry, and disruptive technology that is expected to drive global economic growth for another few decades.

When discussing a topic like blockchain, it's natural to start with themes like technological transformation, the digital economy, competency industries, and the innovation system. This enables us to comprehend the context in which digital disruption occurs.

However, the socio-economic forces that produce interest for technology (or alter in reaction to it) may be as as essential, if not more so, than the digital technology itself. The most successful digital company concepts put people first and digital technology second. Within the educational setting, the phrase is quickly becoming associated with the ability of individual students to own, manage, and share information about their credentials without relying on the education sector as an authorized middleman.

Blockchain technology is perfect for securing, sharing, and verifying learning achievements as a new infrastructure. In the case of certificates, a blockchain can maintain a list of the certificate's issuer and receiver, as well as the document signature (hash), in a public database (the blockchain) that is replicated on thousands of computers all over the world. Digital certificates secured on a blockchain have a number of advantages over 'regular' digital certificates, including the following as:

* Validation of the certificate can be done by anybody with access to the blockchain using freely available open source — no third parties are required.
* The certificate can still be validated even if the organization that issued it no longer exists or no longer has access to the issued record because no intermediary parties are required to validate it.
* They can't be falsified because it's feasible to verify that the certificate was issued and received by the same people who are listed on the certificate.
* The hash is only a means of establishing a 'link' to the user's original content. This suggests that the above approach enables for the publication of a document's signature without publishing the document itself, safeguarding the documents' privacy.
* On a blockchain, the history of issued and received certificates can only be lost if every copy of the program on every computer in the globe is destroyed.

### 2.1.1. Results of Case Studies on the Application of Blockchain Technology in Education

As early blockchain literature frequently refers to ‘self-sovereignty,' or an individual's ability to own and control his or her own identity online, within an educational context, the term is quickly becoming synonymous with the autonomy of individual learners to own, manage, and share details of their credentials without relying on the education institution as a trusted intermediary.

**Open University UK:**

―Imagine a scenario where every learning activity is registered on the Blockchain, including informal learning – together with informal feedback. All assignment test scores will be mapped on learning environments across Europe. Europe-wide analytics could then be developed from the ground up. The best lecturers in Europe by subject could be easily identified. Learning would become that much more interactive – and reputations built on more tangible matrices‖, declared Professor Domingue.

Professor Domingue suggests that the EU consider funding the development of an EU wide blockchain for educational experiments. Funding would be made available for more innovative projects on the same blockchain. It should organize an education program as well as a series of informational meetings for various stakeholders. Colleges, for example, should use blockchains to communicate with other colleges and universities and in different EU countries, fostering collaboration.

#### University of Nicosia

The University of Nicosia (UNIC) has declared several "world firsts" in its commitment to maximizing the potential of blockchain in education. UNIC claims to be the first university to:

* accept Bitcoin as payment for any degree program at the university since October 2013;  has a course about cryptocurrency, called „Introduction to Digital Currencies‖ since January 2014;
* offer an approved academic degree program in digital currency – a Master of Science in Digital Currency – taught online in English (from March 2014, with the first students graduating in June 2016);
* using its own in-house software platform, award academic certifications on the Bitcoin blockchain since September 2014.

―It would be hugely valuable if high schools around the world had some common standard for accreditation and recognition. We cannot have 40 standards on a blockchain. How does this become useful to higher education - which is being fed by secondary education? How can we get everyone to subscribe to the same standard? If any one institution like ours is doing it - it is limited; if a nation state or all higher education institutions and schools in a country come on board – that would be very useful‖, claimed Mr Polemitis.

To conclude, it seems like Blockchain technology are likely to be tested by the majority of EU member states. Others are developing national strategies, while others are testing specialized applications. In addition to the concerns already revealed, there are a few barriers to blockchain adoption in the education sector.

There is little consistency of student data in Europe's educational sector. Education received at the tertiary level has been tokenized and is now represented by credits of learning using one of two credit standards, ECTS or ECVET. However, there are no metadata standards for any credit standard. A diploma supplement that describes the degree in standard terminology is included with all qualifications issued within the European Higher Education Area. However, there are no computer-readable data standards for diploma supplements. There is no standardization of systems, paperwork, or system information for all other levels of education not covered by ECTS or ECVET. While blockchain's capacity to combine various data sources presents considerable development prospects in this field, the absence of standardization hampers progress.

Given the expense of implementing blockchain technology, it is evident that, despite the excitement around the technology, it can only be applied to select use cases from a technical standpoint. As a result, a blockchain-based application should only be used if it fits a specific set of requirements.

## 2.2. Analysis of Digital Education Recognition in Romania

According to [19], in Romania the digitalization of education sector by using Blockchain is still at the proposal level. They intend to use the Blockchain technology for the digital Certificates, Diplomas, for protecting personal data for university/schools. Moreover, it is planned to use the EBSI (European Blockchain Services Infrastructure).

The digitalization of the education and training system has been a priority topic since 2016, with the launch, by the Presidential Administration, of the country project ―Romania educated ‖. In the period 2016-2018, the Presidential Administration held a wide-ranging public debate on education in Romania, starting from a projection of the future and imagining its challenges for today's society. [19]

So far, Romania does not have a national strategy on digitizing the education and training system. The DESI report of the European Commission for Romania 2020 states that ―the extent to which Romania has fulfilled the commitments provided in the strategy (National Strategy on the Digital Agenda for Romania 2020 - n.n.) is unknown; It is also unclear whether Romania plans to evaluate the implementation of the strategy and whether it intends to report on the current situation. " Although it has the best results in terms of connectivity, due to the high use of very high speed broadband and the wide availability of very high capacity fixed networks, especially in urban areas, Romania ranks 26th out of 28 states. EU Member States in the Digital

Economy and Society Index (DESI) for 2020. [19]

Similar to the Member States, in Romania, starting with March 2020, the ―COVID-19‖ crisis has reconfigured educational practices from the ―face-to-face‖ interaction to the online environment. This challenge highlighted the role of digital education as a key objective for highquality, accessible and inclusive teaching-learning, as well as the need for a strategic approach to lifelong digital skills acquisition for all actors involved. During this period, "teaching-learning" has moved mainly in the online environment, and the challenges faced by schools in Romania have been related to:

* lack of predictability;
* heterogeneous school network, with a strong digital divide between schools;
* insufficiently developed digital skills for the efficient organization of the teaching process in the online environment;
* reduced access to technology and reduced internet connectivity;
* reduced opportunities for families to support the beneficiaries of education, children, to participate in online lessons. [19]

Although Romania has a wide range of internet connectivity, steps are still needed to ensure all resources and an integrated framework for access to quality education in the digital age. Based on public consultation, 3 levels of digitization in education have been identified. :

* management and administration, automation and anonymization (records, electronic catalog, reports, checklists, recording of attendance / absences, communication, progress record, anonymization of data)
* didactic activity: teaching-learning processes and evaluation activities (both formative and summative); counseling and guidance activities, psychological and socio-emotional support; extracurricular activities (clubs, non-formal activities); remediation and recovery; activities to promote excellence and high performance;
* a transversal level: communication and efficiency of collaboration (at school / chancellery level, school-family relationship, relations and partnerships: school - local administration - NGO - business environment). [19]

On October 26, 2020, the Ministry of Education and Research launched the process of elaborating the Strategy on the digitization of education in Romania 2021 - 2027, called SMART.Edu - concept focused on the following key concepts: Modern, Accessible School, based on Digital Resources and Technologies. [19]

Regarding the directions of action proposed in the SMART.Edu project, they cover the following areas of interest: developed the digital skills of pupils and students; school curriculum for emerging trades; lifelong digital education; initial and continuous training of teachers for digital education; digital technology infrastructure and resources; connectivity; creation of Open Educational Resources (RED); cyber security, data protection, online security and IT ethics. [19]

# 3. Methodology for collecting data

## 3.1. Objectives of the study

The aim of the paper is to determine the student's knowledge of blockchain technologies and their implementation in the education sector. It also aims to determine the opinion of experts on the adoption of blockchain technology in the education system. Thus, the following secondary objectives are highlighted:

**O1** - Determining students' views on issues to consider before including blockchain technologies in the education sector,

**O2** - Determining the degree to which certain blockchain technologies are suitable (or not) for certain use cases in the education sector,

**O3** - Determining the extent to which certain professions require less or more knowledge of blockchain technologies in terms of their use in the education sector,

**O4** - Determining the degree to which the adoption of blockchain technologies in the education system brings certain benefits,

**O5** - Determining the students' opinion on the challenge of adopting blockchain technologies in the educational system,

**O6** - Determining the opinion of experts on the reasons for using the blockchain in higher education,

**O7** - Determining expert opinion on the most important obstacles that higher education will have to overcome before the blockchain can be widely adopted,

**O8** - Determining the opinion of experts on the data that could exist on the blockchain, **O9** - Determining expert opinion on quality assurance standards to ensure that data are accurate, verifiable and meaningful,

**O10** - Determining the opinion on the verification of the relevant skills when recruiting for a project/dedicated position related to the application of blockchain in higher education (in Romania/Czech Republic/Norway/Iceland).

## 3.2. Development of hypothesis vs questionnaires/interviews

### 3.2.1. Questionnaires (for students). Justification

The impact of the COVID-19 pandemic on society as a whole has accelerated the adoption of technologies that have so far only been found in organizations' long-term plans, such as the blockchain. Blockchain has long been associated with cryptocurrencies, but its use is much more widespread. According to the European Union's executive bureau, the education sector could be revolutionized by blockchain technology. The advantages of blockchain technology are many: the elimination of paper, the reduction of intermediaries, better control of access to data, services and educational products in the digital world can quickly enter the global market, improve the management of student files etc.

The first part of the study is based on finding out the students' perspective on the adoption of blockchain technology in the education system. It is important to know the students' opinion in order to find out their knowledge of blockchain technology, but also the advantages and disadvantages that they consider in using such technology.

The research methods used in the paper are the following: documentary study on the topic, secondary analysis of statistical data, quantitative research by the method of distributing a questionnaire. The research method used is empirical, using primary quantitative research. This research was conducted on the basis of a structured questionnaire.

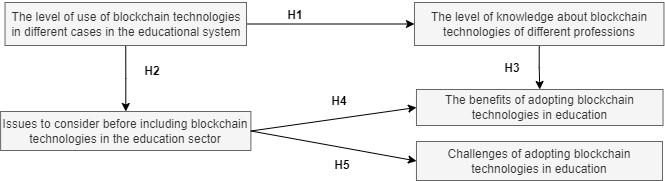
The questionnaire consisted of 10 questions, and its completion resulted in 147 responses from respondents. It was distributed online and was addressed to students at the Faculty of Automation and Computers, Polytechnic University of Bucharest. During the questionnaire, mainly quantitative questions were used (using the Likert ordinal scale), but also qualitative questions to find out the year in which the students first heard about the concept of blockchain technology and in what context. Also, at the beginning of the questionnaire, questions were used to find out information about the respondents (gender and study program).

Quantitative questions (using the ordinal Likerd scale) were mainly used during the questionnaire. Respondents' responses were rated on a scale of 1 to 5 as follows:

* 1 = Not important,
* 2 = Low,
* 3 = Medium,  4 = High,  5 = Very high.

The software used to analyze statistical data and find out the final results was SPSS (Statistical Package for the Social Sciences). Before being entered into the SPSS program, the data was processed using Microsoft Excel.

Figure 3.1 shows the conceptual model and the specific hypotheses for achieving the objectives:



**Figure 3.1: Conceptual model**

The five hypotheses underlying the study are:

**H1** - The use of blockchain technologies in the education sector influences the need for blockchain knowledge in different fields,

**H2** - Issues to consider before including blockchain technologies in the education sector influence the use of blockchain technologies,

**H3** - Knowledge of blockchain technologies in different professions influences the benefits of adopting blockchain technologies,

**H4** - Issues to consider before including blockchain technologies in the education sector influence the benefits of adopting blockchain technologies,

**H5** - Issues to consider before including blockchain technologies in the education sector influence the challenges of adopting blockchain technologies.

### 3.2.2. Interviews (for experts). Justification

The second part of the study is based on the experts' perspective on the adoption of blockchain technology in the education system. Their opinion is important because they have a much wider experience in the field and thus, we can find out the following: the potential applications of blockchain in higher education; what relevant data or learning units would be on the blockchain; quality assurance standards to ensure that the data is accurate, verifiable and meaningful; compelling reasons for using (or not) the blockchain in higher education; the most important obstacles that higher education will have to overcome before the blockchain can be widely adopted; who are the biggest "winners" and "losers" of adopting blockchain technology; if the blockchain in higher education is just hype; observations about blockchain adoption in Romania/Czech Republic/Norway/Iceland in general and in the education field in particular; verification of relevant skills/competencies when recruiting for a dedicated project/position related to the application of blockchain in higher education (in Romania/Czech Republic/Norway/Iceland).

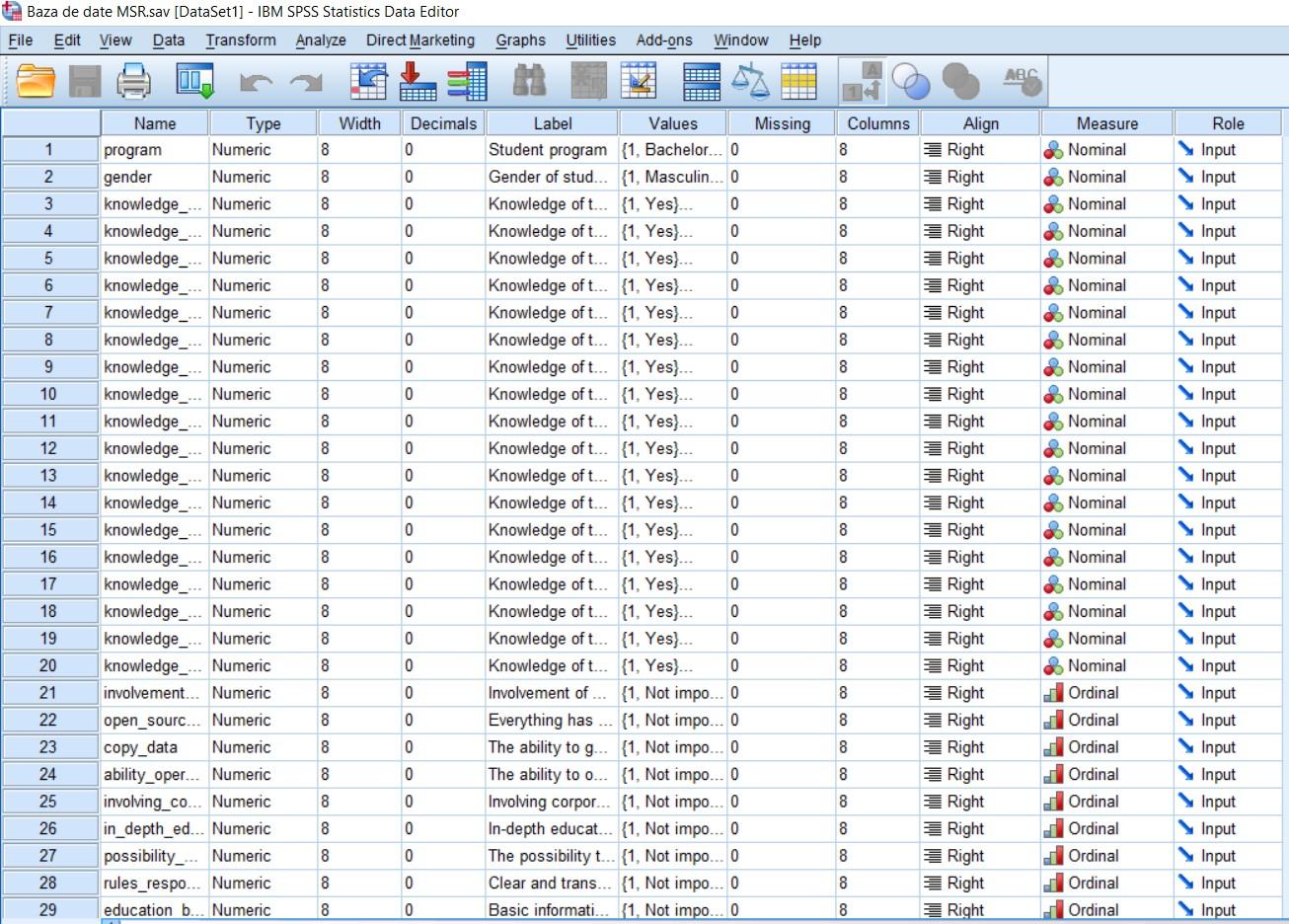
The interview consisted of 13 questions, and its completion resulted in 7 expert answers. Qualitative questions were used during the interview. At the beginning of the questionnaire, questions were also used to find out information about the respondents (type of organization, domain, manager or executive).

# 4. Analysis of data in Romania

## 4.1. Centralization of data

### 4.1.1. Questionnaires (for students)

In order to validate the hypotheses and to be able to achieve the proposed objectives, the data were processed according to Figure 4.1:



**Figure 4.2: Data processing**

In Table 4.1 the frequency of answers to question 1 is presented (study program):

**Table 4.1. Frequency of study program**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Bachelor | 129 | 87,8 | 100,0 | 100,0 |
| Missing | 0 | 18 | 12,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, all the students who answered this question are at bachelor. Also, 18 students did not answer the question.

In Table 4.2 the frequency of answers to question 1 is presented (gender):

**Table 4.2. Frequency of gender**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing  Total | Masculin  Feminin  Total  0 | 91 | 61,9 | 72,8 | 72,8 |
| 34 | 23,1 | 27,2 | 100,0 |
| 125 | 85,0 | 100,0 |  |
| 22 | 15,0 |  |
|  |  |
| 147 | 100,0 |
|  |  |

As can be seen, 91 respondents are male and 34 are female. Also, 22 students did not answer the question.

In Table 4.3 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint a (Smart Contracts):

**Table 4.3: Frequency of question 3 – subpoint a**

##### Knowledge of the term/concept of smart contracts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 67 | 45,6 | 51,1 | 51,1 |
| No | 64 | 43,5 | 48,9 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing  Total | 0 | 16  147 | 10,9 |  |  |
| 100,0 |  |
|  |

As can be seen, 67 students know the term "Smart Contracts" and 64 do not know the term. Also, 16 students did not answer the question.

In Table 4.4 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint b (Multi Signatures):

**Table 4.4: Frequency of question 3 – subpoint b**

##### Knowledge of the term/concept of multi signatures

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 71 | 48,3 | 54,2 | 54,2 |
| 60 | 40,8 | 45,8 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 71 students know the term "Multi Signatures" and 60 do not know the term. Also, 16 students did not answer the question.

In Table 4.5 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint c (Oracles):

**Table 4.5: Frequency of question 3 – subpoint c**

##### Knowledge of the term/concept of oracles

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 72 | 49,0 | 54,5 | 54,5 |
| No | 60 | 40,8 | 45,5 | 100,0 |
| Total | 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 72 students know the term "Oracles" and 60 do not know the term. Also, 15 students did not answer the question.

In Table 4.6 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint d (Decentralized Storage):

**Table 4.6: Frequency of question 3 – subpoint d**

##### Knowledge of the term/concept of decentralized storage

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing Total | Yes  No  Total  0 | 79 | 53,7 | 60,3 | 60,3 |
| 52 | 35,4 | 39,7 | 100,0 |
| 131  16  147 | 89,1 | 100,0 |  |
| 10,9 |  |
|  |
| 100,0 |
|  |

As can be seen, 79 students know the term "Decentralized Storage" and 52 do not know the term.

Also, 16 students did not answer the question.

In Table 4.7 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint e (Private Key):

**Table 4.7: Frequency of question 3 – subpoint e**

##### Knowledge of the term/concept of private key

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 116 | 78,9 | 87,9 | 87,9 |
| 16 | 10,9 | 12,1 | 100,0 |
| Total | 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 116 students know the term "Private Key" and 16 do not know the term. Also, 15 students did not answer the question.

In Table 4.8 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint f (Validation Process):

**Table 4.8: Frequency of question 3 – subpoint f**

##### Knowledge of the term/concept of validation process

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 114 | 77,6 | 86,4 | 86,4 |
| No | 18 | 12,2 | 13,6 | 100,0 |
| Total | 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 114 students know the term "Validation Process" and 18 do not know the term. Also, 15 students did not answer the question.

In Table 4.9 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint g (Blockchain Fork):

**Table 4.9: Frequency of question 3 – subpoint g**

##### Knowledge of the term/concept of blockchain fork

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing Total | Yes  No  Total  0 | 60 | 40,8 | 45,8 | 45,8 |
| 71 | 48,3 | 54,2 | 100,0 |
| 131  16  147 | 89,1 | 100,0 |  |
| 10,9 |  |
|  |
| 100,0 |
|  |

As can be seen, 60 students know the term "Blockchain Fork" and 71 do not know the term.

Also, 16 students did not answer the question.

In Table 4.10 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint h (Hashpower):

**Table 4.10: Frequency of question 3 – subpoint h**

##### Knowledge of the term/concept of hashpower

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 62 | 42,2 | 47,3 | 47,3 |
| 69 | 46,9 | 52,7 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 62 students know the term "Hashpower" and 69 do not know the term. Also, 16 students did not answer the question.

In Table 4.11 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint i (Proof of Work):

**Table 4.11: Frequency of question 3 – subpoint i**

##### Knowledge of the term/concept of proof of work (PoW)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 63 | 42,9 | 48,1 | 48,1 |
| No | 68 | 46,3 | 51,9 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 63 students know the term "Proof of Work" and 68 do not know the term. Also, 16 students did not answer the question.

In Table 4.12 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint j (Proof of Stake):

**Table 4.12: Frequency of question 3 – subpoint j**

##### Knowledge of the term/concept of proof of stake (PoS)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing Total | Yes  No  Total  0 | 55 | 37,4 | 42,0 | 42,0 |
| 76 | 51,7 | 58,0 | 100,0 |
| 131  16  147 | 89,1 | 100,0 |  |
| 10,9 |  |
|  |
| 100,0 |
|  |

As can be seen, 55 students know the term "Proof of Work" and 76 do not know the term. Also, 16 students did not answer the question.

In Table 4.13 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint k (Block Reward):

**Table 4.13: Frequency of question 3 – subpoint k**

##### Knowledge of the term/concept of block reward

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 54 | 36,7 | 41,5 | 41,5 |
| 76 | 51,7 | 58,5 | 100,0 |
| Total | 130 | 88,4 | 100,0 |  |
| Missing | 0 | 17 | 11,6 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 54 students know the term "Block Reward" and 76 do not know the term. Also, 17 students did not answer the question.

In Table 4.14 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint l (Wallets):

**Table 4.14: Frequency of question 3 – subpoint l**

##### Knowledge of the term/concept of wallets

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 115 | 78,2 | 87,8 | 87,8 |
| No | 16 | 10,9 | 12,2 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 115 students know the term "Wallets" and 16 do not know the term. Also, 16 students did not answer the question.

In Table 4.15 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint m (Public Address):

**Table 4.15: Frequency of question 3 – subpoint m**

##### Knowledge of the term/concept of public\_address

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Yes  No  Total | 114 | 77,6 | 86,4  13,6  100,0 | 86,4 |
| 18 | 12,2 | 100,0 |
| 132  15  147 | 89,8 |  |
| 0 | 10,2 |  |
|  |  |
| Total |  | 100,0 |
|  | |  |

As can be seen, 114 students know the term "Public Address" and 18 do not know the term.

Also, 15 students did not answer the question.

In Table 4.16 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint n (Transaction Fees):

**Table 4.16: Frequency of question 3 – subpoint n**

##### Knowledge of the term/concept of transaction fees

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 111 | 75,5 | 84,7 | 84,7 |
| 20 | 13,6 | 15,3 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 111 students know the term "Transaction Fees" and 20 do not know the term. Also, 16 students did not answer the question.

In Table 4.17 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint o (Blockchain Bloat):

**Table 4.17: Frequency of question 3 – subpoint o**

##### Knowledge of the term/concept of blockchain bloat

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 36 | 24,5 | 27,5 | 27,5 |
| No | 95 | 64,6 | 72,5 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 36 students know the term "Blockchain Bloat" and 95 do not know the term. Also, 16 students did not answer the question.

In Table 4.18 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint p (Mining):

**Table 4.18: Frequency of question 3 – subpoint p**

##### Knowledge of the term/concept of mining

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing Total | Yes  No  Total  0 | 119 | 81,0 | 91,5 | 91,5 |
| 11 | 7,5 | 8,5 | 100,0 |
| 130  17  147 | 88,4 | 100,0 |  |
| 11,6 |  |
|  |
| 100,0 |
|  |

As can be seen, 119 students know the term "Mining" and 11 do not know the term. Also, 17 students did not answer the question.

In Table 4.19 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint q (Cryptographic hash function):

**Table 4.19: Frequency of question 3 – subpoint q**

##### Knowledge of the term/concept of cryptographic hash function

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes  No | 100 | 68,0 | 76,3 | 76,3 |
| 31 | 21,1 | 23,7 | 100,0 |
| Total | 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 100 students know the term "Cryptographic hash function" and 31 do not know the term. Also, 16 students did not answer the question.

In Table 4.20 the frequency of answers to question 3 (I have already heard of the following terms and concepts) subpoint r (Hashtable):

**Table 4.20: Frequency of question 3 – subpoint r**

##### Knowledge of the term/concept of hashtable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Yes | 105 | 71,4 | 79,5 | 79,5 |
| No | 27 | 18,4 | 20,5 | 100,0 |
| Total | 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 105 students know the term "Hashtable" and 27 do not know the term. Also, 15 students did not answer the question.

In Table 4.21 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint a (Involvement of Government, strict worldwide regulation):

**Table 4.21: Frequency of question 4 – subpoint a**

##### Involvement of Government, strict worldwide regulation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 11 | 7,5 | 8,4 | 8,4 30,5  61,8  84,7  100,0 |
| 29 | 19,7 | 22,1 |
| 41 | 27,9 | 31,3 |
| 30 | 20,4 | 22,9 |
| 20 | 13,6 | 15,3 |
| 131 | 89,1 | 100,0 |
| 16 | 10,9 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, that 11 students consider to Government, strict worldwide regulation is not important to consider; 29 students consider it little to consider; 41 students consider it to be an average measure to consider; 30 considers it important to consider, and 20 considers it highly important to consider. Also, 16 students did not answer the question.

In Table 4.22 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint b (Everything has to be set up with open-source technologies):

**Table 4.22: Frequency of question 4 – subpoint b**

##### Everything has to be set up with open-source technologies

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 3 | 2,0 | 2,3 | 2,3 |
| 14 | 9,5 | 10,6 | 12,9 |
| 26 | 17,7 | 19,7 | 32,6 |
| 49 | 33,3 | 37,1 | 69,7 |
| 40 | 27,2 | 30,3 | 100,0 |
| 132 15 | 89,8 | 100,0 |  |
| 10,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students believes is not important to consider that everything has to be set up with open-source technologies; 14 students think is little to consider; 26 students think it is average important to consider; 49 think it is important to consider, and 40 considers it is highly important to consider. Also, 15 students did not answer the question.

In Table 4.23 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint c (The ability to get a copy of my own data that can be stored on my own node, regardless of which blockchain system was originally used):

**Table 4.23: Frequency of question 4 – subpoint c**

**The ability to get a copy of my own data that can be stored on my own node, regardless of which blockchain system was**

##### originally used

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 1 | ,7 | ,8 | ,8 |
| 4 | 2,7 | 3,0 | 3,8 |
| 29 | 19,7 | 22,0 | 25,8 |
| 43 | 29,3 | 32,6 | 58,3 |
| 55 | 37,4 | 41,7 | 100,0 |
| 132 15 | 89,8 | 100,0 |  |
| 10,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, one student believes that the ability to obtain a copy of one's own data that can be stored on one's own node, regardless of the blockchain system initially used, is not important to consider; 4 students think it is little import to consider; 29 students think it is average important to consider; 43 think it is important to consider, and 55 think it is highly important to consider. Also, 15 students did not answer the question.

In Table 4.24 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint d (The ability to operate a full node and store an encrypted copy of the blockchain used to store credentials):

**Table 4.24: Frequency of question 4 – subpoint d**

##### The ability to operate a full node and store an encrypted copy of the blockchain used to store credentials.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 3 | 2,0 | 2,3 | 2,3 |
| 7 | 4,8 | 5,4 | 7,7 |
| 29 | 19,7 | 22,3 | 30,0 |
| 48 | 32,7 | 36,9 | 66,9 |
| 43 | 29,3 | 33,1 | 100,0 |
| 130 17 | 88,4 | 100,0 |  |
| 11,6 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students are of the opinion that the ability to operate a complete node and store an encrypted copy of the blockchain used to store credentials is not important to consider; 7 students think it is little import to consider; 29 students think it is average important to consider; 48 think it is important to consider, and 43 think it is highly important to consider. Also, 17 students did not answer the question.

In Table 4.25 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint e (Involving corporations in the process of setting up Blockchain-technologies in the educational sector):

**Table 4.25: Frequency of question 4 – subpoint e**

##### Involving corporations in the process of setting up Blockchain-technologies in the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 12 | 8,2 | 9,2 | 9,2 |
| 20 | 13,6  27,9  20,4 | 15,4 | 24,6 |
| 41 | 31,5 | 56,2 |
| 30 | 23,1 | 79,2 |
| 27 | 18,4 | 20,8 | 100,0 |
| 130 17 | 88,4 | 100,0 |  |
| 11,6 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 12 students are of the opinion that the involvement of corporations in the process of setting up Blockchain technologies in the education sector is not important to consider; 20 students think it is little import to consider; 41 students think it is average important to consider; 30 think it is important to consider, and 27 think it is highly important to consider. Also, 17 students did not answer the question.

In Table 4.26 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint f (In-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector):

**Table 4.26: Frequency of question 4 – subpoint f**

##### In-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educationalsector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 4 | 2,7 | 3,1 | 3,1 |
| 23 | 15,6 | 17,6 | 20,6 |
| 30 | 20,4 | 22,9 | 43,5 |
| 74 | 50,3 | 56,5 | 100,0 |
| 131 16 | 89,1 | 100,0 |  |
| 10,9 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 0 students are of the opinion that in-depth education about blockchaintechnologies for IT-professionals and administrative-officers in the educational-sector is not important to consider; 4 students think it is little import to consider; 23 students think it is average important to consider; 30 think it is important to consider, and 74 think it is highly important to consider. Also, 16 students did not answer the question.

In Table 4.27 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint g (The possibility to process information from various blockchain-systems):

**Table 4.27: Frequency of question 4 – subpoint g**

##### The possibility to process information from various blockchain-systems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 1 | ,7 | ,8 | ,8 |
| 9 | 6,1  21,1 | 6,9 | 7,7 |
| 31 | 23,8 | 31,5 |
| 45 | 30,6 | 34,6 | 66,2 |
| 44 | 29,9 | 33,8 | 100,0 |
| 130 17 | 88,4 | 100,0 |  |
| 11,6 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student are of the opinion that the possibility to process information from various blockchain-systems is not important to consider; 9 students think it is little import to consider; 31 students think it is average important to consider; 45 think it is important to consider, and 44 think it is highly important to consider. Also, 17 students did not answer the question.

In Table 4.28 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint h (Clear and transparent rules about who is responsible for payment of fees):

**Table 4.28: Frequency of question 4 – subpoint h**

##### Clear and transparent rules about who is responsible for payment of fees

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 3 | 2,0 | 2,3 | 2,3 |
| 12 | 8,2 | 9,3 | 11,6 |
| 26 | 17,7 | 20,2 | 31,8 |
| 88 | 59,9 | 68,2 | 100,0 |
| 129 18 | 87,8 | 100,0 |  |
| 12,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 0 students are of the opinion that clear and transparent rules about who is responsible for payment of fees is not important to consider; 3 students think it is little import to consider; 12 students think it is average important to consider; 26 think it is important to consider, and 88 think it is highly important to consider. Also, 18 students did not answer the question.

In Table 4.29 the frequency of answers to question 4 (The following aspects are in my opinion necessary to consider before including blockchain-technologies within the educational sector) subpoint I (Basic information/education about blockchain-technologies for all people involved in the educational sector):

**Table 4.29: Frequency of question 4 – subpoint i**

##### Basic information/education about blockchain-technologies for all people involved in the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 2 | 1,4 | 1,5 | 1,5 |
| 1 | ,7 | ,8 | 2,3 |
| 18 | 12,2 | 13,7 | 16,0 |
| 33 | 22,4 | 25,2 | 41,2 |
| 77 | 52,4  89,1 | 58,8 | 100,0 |
| 131 16 | 100,0 |  |
| 10,9 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 2 students are of the opinion that basic information/education about blockchain technologies for all people involved in the educational sector is not important to consider; 1 student think it is little import to consider; 18 students think it is average important to consider; 33 think it is important to consider, and 77 think it is highly important to consider. Also, 16 students did not answer the question.

In Table 4.30 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint a (Certificates management):

**Table 4.30: Frequency of question 5 – subpoint a**

##### Use in the educational sector - Certificates management

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total  0 | 2 | 1,4 | 1,5 | 1,5 |
| 13 | 8,8 | 9,8 | 11,3 |
| 39 | 26,5 | 29,3 | 40,6 |
| 31 | 21,1 | 23,3 | 63,9 |
| 48 | 32,7 | 36,1 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| 14 | 9,5 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 2 students consider that blockchain-technologies are not suitable for certificates management; 13 students consider that they are little suitable; 39 students consider that they are average suitable; 31 students consider that they are suitable, and 48 students consider that they are highly suitable. Also, 14 students did not answer the question.

In Table 4.31 the frequency of answers to question 5 (In my opinion blockchaintechnologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint b (Competencies and learning outcomes management):

**Table 4.31: Frequency of question 5 – subpoint b**

##### Use in the educational sector - Competencies and learning outcomes management

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total  0 | 3 | 2,0 | 2,3 | 2,3 |
| 23 | 15,6 | 17,4 | 19,7 |
| 45 | 30,6 | 34,1 | 53,8 |
| 36 | 24,5 | 27,3 | 81,1 |
| 25 | 17,0  89,8 | 18,9  100,0 | 100,0 |
| 132 |  |
| 15 | 10,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students consider that blockchain-technologies are not suitable for competencies and learning outcomes management; 23 students consider that they are little suitable; 45 students consider that they are average suitable; 36 students consider that they are suitable, and 25 students consider that they are highly suitable. Also, 15 students did not answer the question.

In Table 4.32 the frequency of answers to question 5 (In my opinion blockchaintechnologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint c (Evaluating students’ professional ability):

**Table 4.32: Frequency of question 5 – subpoint c**

##### Use in the educational sector - Evaluating students’ professional ability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total  0 | 10 | 6,8 | 7,5 | 7,5 |
| 33 | 22,4 | 24,8 | 32,3 |
| 38 | 25,9 | 28,6 | 60,9 |
| 34 | 23,1 | 25,6 | 86,5 |
| 18 | 12,2 | 13,5 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| 14 | 9,5 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 10 students consider that blockchain-technologies are not suitable for evaluating students’ professional ability; 33 students consider that they are little suitable; 38 students consider that they are average suitable; 34 students consider that they are suitable, and 18 students consider that they are highly suitable. Also, 14 students did not answer the question.

In Table 4.33 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint d (Securing collaborative learning environment):

**Table 4.33: Frequency of question 5 – subpoint d**

##### Use in the educational sector - Securing collaborative learning environment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total  0 | 2 | 1,4 | 1,5 | 1,5 |
| 13 | 8,8 | 9,8 | 11,4 |
| 34 | 23,1 | 25,8 | 37,1 |
| 47 | 32,0 | 35,6 | 72,7 |
| 36 | 24,5 | 27,3 | 100,0 |
| 132 | 89,8 | 100,0 |  |
| 15 | 10,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 2 students consider that blockchain-technologies are not suitable for securing collaborative learning environment; 13 students consider that they are little suitable; 34 students consider that they are average suitable; 47 students consider that they are suitable, and 36 students consider that they are highly suitable. Also, 15 students did not answer the question.

In Table 4.34 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint e (Protecting learning objects):

**Table 4.34: Frequency of question 5 – subpoint e**

##### Use in the educational sector - Protecting learning objects

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total  0 | 1 | ,7 | ,8 | ,8 |
| 16 | 10,9 | 12,0 | 12,8 |
| 31 | 21,1  31,3  26,5 | 23,3  34,6  29,3 | 36,1 |
| 46 | 70,7 |
| 39 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| 14 | 9,5 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student consider that blockchain-technologies are not suitable for protecting learning objects; 16 students consider that they are little suitable; 31 students consider that they are average suitable; 46 students consider that they are suitable, and 39 students consider that they are highly suitable. Also, 14 students did not answer the question.

In Table 4.35 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint f (Fees and credits transfer):

**Table 4.35: Frequency of question 5 – subpoint f**

##### Use in the educational sector - Fees and credits transfer

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total | 3 | 2,0 | 2,3 | 2,3 |
| 12 | 8,2 | 9,0 | 11,3 |
| 28 | 19,0 | 21,1 | 32,3 |
| 26 | 17,7 | 19,5 | 51,9 |
| 64 | 43,5 | 48,1 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| Missing | 0 | 14 | 9,5 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students consider that blockchain-technologies are not suitable for fees and credits transfer; 12 students consider that they are little suitable; 28 students consider that they are average suitable; 26 students consider that they are suitable, and 64 students consider that they are highly suitable. Also, 14 students did not answer the question.

In Table 4.36 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint g (Obtaining digital guardianship consent):

**Table 4.36: Frequency of question 5 – subpoint g**

##### Use in the educational sector - Obtaining digital guardianship consent

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total | 3 | 2,0 | 2,3 | 2,3 |
| 14 | 9,5 | 10,6 | 12,9 |
| 41 | 27,9  23,8 | 31,1  26,5 | 43,9 |
| 35 | 70,5 |
| 39 | 26,5 | 29,5 | 100,0 |
| 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students consider that blockchain-technologies are not suitable for obtaining digital guardianship consent; 14 students consider that they are little suitable; 41 students consider that they are average suitable; 35 students consider that they are suitable, and 39 students consider that they are highly suitable. Also, 15 students did not answer the question.

In Table 4.37 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint h (Copyrights management):

**Table 4.37: Frequency of question 5 – subpoint h**

##### Use in the educational sector - Copyrights management

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total | 3 | 2,0 | 2,3 | 2,3 |
| 11 | 7,5 | 8,3 | 10,6 |
| 21 | 14,3 | 15,9 | 26,5 |
| 46 | 31,3 | 34,8 | 61,4 |
| 51 | 34,7 | 38,6 | 100,0 |
| 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students consider that blockchain-technologies are not suitable for copyrights management; 11 students consider that they are little suitable; 21 students consider that they are average suitable; 46 students consider that they are suitable, and 51 students consider that they are highly suitable. Also, 15 students did not answer the question.

In Table 4.38 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint i (Enhancing students’ interactions in e-learning):

**Table 4.38: Frequency of question 5 – subpoint i**

##### Use in the educational sector - Enhancing students’ interactions in e-learning

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable | 5 | 3,4 | 3,8 | 3,8 |
|  | Little suitable  Average suitable  Suitable  Highly suitable  Total | 19 | 12,9 | 14,3 | 18,0 |
| 35 | 23,8  22,4 | 26,3  24,8 | 44,4 |
| 33 | 69,2 |
| 41 | 27,9 | 30,8 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| Missing | 0 | 14 | 9,5 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 5 students consider that blockchain-technologies are not suitable for enhancing students’ interactions in e-learning; 19 students consider that they are little suitable; 35 students consider that they are average suitable; 33 students consider that they are suitable, and 41 students consider that they are highly suitable. Also, 14 students did not answer the question.

In Table 4.39 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint j (Supporting lifelong learning):

**Table 4.39: Frequency of question 5 – subpoint j**

##### Use in the educational sector - Supporting lifelong learning

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable  Little suitable  Average suitable  Suitable  Highly suitable  Total | 6 | 4,1 | 4,6 | 4,6 |
| 19 | 12,9 | 14,6 | 19,2 |
| 31 | 21,1 | 23,8 | 43,1 |
| 39 | 26,5 | 30,0 | 73,1 |
| 35 | 23,8 | 26,9 | 100,0 |
| 130 | 88,4 | 100,0 |  |
| Missing | 0 | 17 | 11,6 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 6 students consider that blockchain-technologies are not suitable for supporting lifelong learning; 19 students consider that they are little suitable; 31 students consider that they are average suitable; 39 students consider that they are suitable, and 35 students consider that they are highly suitable. Also, 17 students did not answer the question.

In Table 4.40 the frequency of answers to question 5 (In my opinion blockchain technologies are suitable (or not suitable) for the following use cases within the educational sector) subpoint k (Allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain):

**Table 4.40: Frequency of question 5 – subpoint k**

##### Use in the educational sector - Allowing employers and other organizations to view student’ educational results and other qualifications on a blockchain

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not suitable  Little suitable  Average suitable | 14 | 9,5 | 10,7 | 10,7 |
| 23 | 15,6 | 17,6 | 28,2 |
| 30 | 20,4 | 22,9 | 51,1 |
|  | Suitable  Highly suitable  Total | 30 | 20,4 | 22,9 | 74,0 |
| 34 | 23,1  89,1 | 26,0  100,0 | 100,0 |
| 131 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 14 students consider that blockchain-technologies are not suitable for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain; 23 students consider that they are little suitable; 30 students consider that they are average suitable; 30 students consider that they are suitable, and 34 students consider that they are highly suitable. Also, 16 students did not answer the question.

In Table 4.41 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint a (Teacher):

**Table 4.41: Frequency of question 6 – subpoint a**

##### Teacher - Knowledge of blockchain-technologiesin the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total | 9 | 6,1 | 6,9 | 6,9 |
| 24 | 16,3 | 18,5 | 25,4 |
| 25 | 17,0 | 19,2 | 44,6 |
| 31 | 21,1 | 23,8 | 68,5 |
| 41 | 27,9 | 31,5 | 100,0 |
| 130 | 88,4 | 100,0 |  |
| Missing | 0 | 17 | 11,6 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 9 students consider for the teacher not knowledge needed of blockchain technologies, in terms of their use in the education sector; 24 students consider it little knowledge needed; 25 students consider it average knowledge needed; 31 students consider it knowledge needed, and 41 students consider it high knowledge needed. Also, 17 students did not answer the question.

In Table 4.42 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint b (Administrative IT-Officer):

**Table 4.42: Frequency of question 6 – subpoint b**

##### Administrative IT-Officer - Knowledge of blockchain-technologiesin the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Little knowledge needed  Average knowledge needed Knowledge needed  High knowledge needed | 4 | 2,7 | 3,0 | 3,0 |
| 13 | 8,8 | 9,8 | 12,9 |
| 35 | 23,8 | 26,5 | 39,4 |
| 80 | 54,4 | 60,6 | 100,0 |
|  | Total | 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 0 students consider for the administrative IT-Officer not knowledge needed of blockchain technologies, in terms of their use in the education sector; 4 students consider it little knowledge needed; 13 students consider it average knowledge needed; 35 students consider it knowledge needed, and 80 students consider it high knowledge needed. Also, 15 students did not answer the question.

In Table 4.43 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint c (Administrative Non-IT Officer):

**Table 4.43: Frequency of question 6 – subpoint c**

##### Administrative Non-IT-Officer - Knowledge of blockchain-technologiesin the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total  0 | 13 | 8,8 | 9,9 | 9,9 |
| 44 | 29,9 | 33,6 | 43,5 |
| 42 | 28,6 | 32,1 | 75,6 |
| 21 | 14,3 | 16,0 | 91,6 |
| 11 | 7,5 | 8,4 | 100,0 |
| 131 16 | 89,1 | 100,0 |  |
| 10,9 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 13 students consider for the administrative Non-IT-Officer not knowledge needed of blockchain technologies, in terms of their use in the education sector; 44 students consider it little knowledge needed; 42 students consider it average knowledge needed; 21 students consider it knowledge needed, and 11 students consider it high knowledge needed. Also, 16 students did not answer the question.

In Table 4.44 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint d (Headmaster/Rector/Dean):

**Table 4.44: Frequency of question 6 – subpoint d**

##### Headmaster/Rector/Dean - Knowledge of blockchain-technologiesin the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total  0 | 5 | 3,4  13,6 | 3,8 | 3,8 |
| 20 | 15,3 | 19,1 |
| 41 | 27,9 | 31,3 | 50,4 |
| 32 | 21,8 | 24,4 | 74,8 |
| 33 | 22,4 | 25,2 | 100,0 |
| 131 16 | 89,1 | 100,0 |  |
| 10,9 |  |

##### Headmaster/Rector/Dean - Knowledge of blockchain-technologiesin the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total | 5 | 3,4 13,6  27,9 | 3,8 | 3,8 |
| 20 | 15,3 | 19,1 |
| 41 | 31,3 | 50,4 |
| 32 | 21,8 | 24,4 | 74,8 |
| 33 | 22,4  89,1 | 25,2 | 100,0 |
| 131 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 5 students consider for the Headmaster/Rector/Dean not knowledge needed of blockchain technologies, in terms of their use in the education sector; 20 students consider it little knowledge needed; 41 students consider it average knowledge needed; 32 students consider it knowledge needed, and 33 students consider it high knowledge needed. Also, 16 students did not answer the question.

In Table 4.45 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint e (Educational App-Developer):

**Table 4.45: Frequency of question 6 – subpoint e**

##### Educational App-Developer - Knowledge of blockchain-technologies in the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total | 3 | 2,0 | 2,3 | 2,3 |
| 15 | 10,2 | 11,5 | 13,7 |
| 48 | 32,7 | 36,6 | 50,4 |
| 65 | 44,2 | 49,6 | 100,0 |
| 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 0 students consider for the Educational App-Developer not knowledge needed of blockchain technologies, in terms of their use in the education sector; 3 students consider it little knowledge needed; 15 students consider it average knowledge needed; 48 students consider it knowledge needed, and 65 students consider it high knowledge needed. Also, 16 students did not answer the question.

In Table 4.46 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint f (Researcher in the field of education and educational technologies):

**Table 4.46: Frequency of question 6 – subpoint f**

##### Researcher in the field of education and educational technologies - Knowledge of blockchain-technologies in the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total | 1 | ,7 | ,8 | ,8 |
| 2 | 1,4 | 1,5 | 2,3 |
| 19 | 12,9  25,9 | 14,4 | 16,7 |
| 38 | 28,8 | 45,5 |
| 72 | 49,0 | 54,5 | 100,0 |
| 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student consider for the researcher in the field of education and educational technologies not knowledge needed of blockchain technologies, in terms of their use in the education sector; 2 students consider it little knowledge needed; 19 students consider it average knowledge needed; 38 students consider it knowledge needed, and 72 students consider it high knowledge needed. Also, 15 students did not answer the question.

In Table 4.47 the frequency of answers to question 6 (Please rank which professions require lower or higher knowledge of blockchain-technologies, regarding their use in the educational sector) subpoint g (Hardware/software Specialist):

**Table 4.47: Frequency of question 6 – subpoint g**

##### Hardware/Software Specialist - Knowledge of blockchain-technologies in the educational sector

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not knowledge needed  Little knowledge needed  Average knowledge needed  Knowledge needed  High knowledge needed  Total | 1 | ,7 | ,8 | ,8 |
| 3 | 2,0 | 2,3 | 3,0 |
| 14 | 9,5 | 10,6 | 13,6 |
| 28 | 19,0 | 21,2 | 34,8 |
| 86 | 58,5 | 65,2 | 100,0 |
| 132 | 89,8 | 100,0 |  |
| Missing | 0 | 15 | 10,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student consider for hardware/software Specialist not knowledge needed of blockchain technologies, in terms of their use in the education sector; 3 students consider it little knowledge needed; 14 students consider it average knowledge needed; 28 students consider it knowledge needed, and 86 students consider it high knowledge needed. Also, 15 students did not answer the question.

In Table 4.48 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint a (Enhancing learners' activity):

**Table 4.48: Frequency of question 7 – subpoint a**

##### Benefit of blockchain technologies - Enhancing learners' activity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 5 | 3,4 | 3,8 | 3,8 |
| 11 | 7,5 | 8,3 | 12,0 |
| 43 | 29,3  27,2 | 32,3 | 44,4 |
| 40 | 30,1 | 74,4 |
| 34 | 23,1 | 25,6 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| Missing | 0 | 14 | 9,5 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 5 students are of the opinion that enhancing learners' activity is not important to consider as a benefit of adopting blockchain technologies in education; 11 students think it is little import to consider; 43 students think it is average import to consider; 40 students think it is import to consider; and 34 students think it is highly import to consider. Also, 14 students did not answer the question.

In Table 4.49 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint b (Supporting learners' career decisions):

**Table 4.49: Frequency of question 7 – subpoint b**

##### Benefit of blockchain technologies - Supporting learners' career decisions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 5 | 3,4 | 3,8 | 3,8 |
| 11 | 7,5 | 8,3 | 12,0 |
| 40 | 27,2 | 30,1 | 42,1 |
| 46 | 31,3 | 34,6 | 76,7 |
| 31 | 21,1 | 23,3 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| Missing | 0 | 14 | 9,5 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 5 students are of the opinion that supporting learners' career decisions is not important to consider as a benefit of adopting blockchain technologies in education; 11 students think it is little import to consider; 40 students think it is average import to consider; 46 students think it is important to consider; and 31 students think it is highly import to consider. Also, 14 students did not answer the question.

In Table 4.50 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint c (Improving management of student’s records):

**Table 4.50: Frequency of question 7 – subpoint c**

##### Benefit of blockchain technologies - Improving management of student’s records

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider | 5 | 3,4 | 3,8 | 3,8 |
|  | Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 10 | 6,8 | 7,5 | 11,3 |
| 30 | 20,4  29,3 | 22,6 | 33,8 |
| 43 | 32,3 | 66,2 |
| 45 | 30,6 | 33,8 | 100,0 |
| 133 | 90,5 | 100,0 |  |
| Missing | 0 | 14 | 9,5 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 5 students are of the opinion that improving management of student’s records is not important to consider as a benefit of adopting blockchain technologies in education; 10 students think it is little import to consider; 30 students think it is average import to consider; 43 students think it is important to consider; and 45 students think it is highly import to consider. Also, 14 students did not answer the question.

In Table 4.51 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint d (Enhancing trust):

**Table 4.51: Frequency of question 7 – subpoint d**

##### Benefit of blockchain technologies - Enhancing trust

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 3 | 2,0 | 2,3 | 2,3 |
| 14 | 9,5 | 10,7 | 13,0 |
| 22 | 15,0 | 16,8 | 29,8 |
| 46 | 31,3 | 35,1 | 64,9 |
| 46 | 31,3 | 35,1 | 100,0 |
| 131 | 89,1 | 100,0 |  |
| Missing | 0 | 16 | 10,9 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students are of the opinion that enhancing trust is not important to consider as a benefit of adopting blockchain technologies in education; 14 students think it is little import to consider; 22 students think it is average import to consider; 46 students think it is import to consider; and 46 students think it is highly import to consider. Also, 16 students did not answer the question.

In Table 4.52 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint e (Identity authentication):

**Table 4.52: Frequency of question 7 – subpoint e**

##### Benefit of blockchain technologies - Identity authentication

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 10 | 6,8  13,6 | 7,8 | 7,8 |
| 20 | 15,5 | 23,3 |
| 40 | 27,2 | 31,0 | 54,3 |
| 59 | 40,1 | 45,7 | 100,0 |
| 129 | 87,8 | 100,0 |  |
| Missing | 0 | 18 | 12,2 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 0 students are of the opinion that identity authentication is not important to consider as a benefit of adopting blockchain technologies in education; 10 students think it is little import to consider; 20 students think it is average import to consider; 40 students think it is import to consider; and 59 students think it is highly import to consider. Also, 18 students did not answer the question.

In Table 4.53 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint f (Better control of data access):

**Table 4.53: Frequency of question 7 – subpoint f**

##### Benefit of blockchain technologies - Better control of data access

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 1 | ,7 | ,8 | ,8 |
| 6 | 4,1 | 4,5 | 5,3 |
| 17 | 11,6 | 12,8 | 18,0 |
| 44 | 29,9 | 33,1 | 51,1 |
| 65 | 44,2 | 48,9 | 100,0 |
| 133 14 | 90,5 | 100,0 |  |
| 9,5 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student are of the opinion that better control of data access is not important to consider as a benefit of adopting blockchain technologies in education; 6 students think it is little import to consider; 17 students think it is average import to consider; 44 students think it is import to consider; and 65 students think it is highly import to consider. Also, 14 students did not answer the question.

In Table 4.54 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint g (Enhancing students’ assessment):

**Table 4.54: Frequency of question 7 – subpoint g**

##### Benefit of blockchain technologies - Enhancing students’ assessment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 7 | 4,8 | 5,3 | 5,3 |
| 17 | 11,6 | 12,8 | 18,0 |
| 39 | 26,5 | 29,3 | 47,4 |
| 49 | 33,3 | 36,8 | 84,2 |
| 21 | 14,3 | 15,8 | 100,0 |
| 133 14 | 90,5 | 100,0 |  |
| 9,5 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 7 students are of the opinion that enhancing students’ assessment is not important to consider as a benefit of adopting blockchain technologies in education; 17 students think it is little import to consider; 39 students think it is average import to consider; 49 students think it is import to consider; and 21 students think it is highly import to consider. Also, 14 students did not answer the question.

In Table 4.55 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint h (Low cost):

**Table 4.55: Frequency of question 7 – subpoint h**

##### Benefit of blockchain technologies - Low cost

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 2 | 1,4 | 1,5 | 1,5 |
| 26 | 17,7  27,9 | 19,8 | 21,4 |
| 41 | 31,3 | 52,7 |
| 29 | 19,7 | 22,1 | 74,8 |
| 33 | 22,4 | 25,2 | 100,0 |
| 131 16 | 89,1 | 100,0 |  |
| 10,9 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 2 students are of the opinion that low cost is not important to consider as a benefit of adopting blockchain technologies in education; 26 students think it is little import to consider; 41 students think it is average import to consider; 29 students think it is important to consider; and 33 students think it is highly import to consider. Also, 16 students did not answer the question.

In Table 4.56 the frequency of answers to question 7 (Benefit of adopting blockchain technologies in education) subpoint i (High security):

**Table 4.56: Frequency of question 7 – subpoint i**

##### Benefit of blockchain technologies - High security

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 1 | ,7 | ,8 | ,8  6,1 11,4  31,8  100,0 |
| 7 | 4,8 | 5,3 |
| 7 | 4,8 | 5,3 |
| 27 | 18,4 | 20,5 |
| 90 | 61,2 | 68,2 |
| 132 | 89,8 | 100,0 |
| 15 | 10,2 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 1 student are of the opinion that high security is not important to consider as a benefit of adopting blockchain technologies in education; 7 students think it is little import to consider; 7 students think it is average import to consider; 27 students think it is important to consider; and 90 students think it is highly import to consider. Also, 15 students did not answer the question.

In Table 4.57 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint a (Weakening traditional school credentials):

**Table 4.57: Frequency of question 8 – subpoint a**

##### Challenges of blockchain technologies - Weakening traditional school credentials

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid  Missing | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total  0 | 28 | 19,0 | 19,4 | 19,4 |
| 28 | 19,0 | 19,4 | 38,9 |
| 48 | 32,7  13,6  13,6  98,0 | 33,3 | 72,2 |
| 20 | 13,9 | 86,1 |
| 20 | 13,9 | 100,0 |
| 144 3 | 100,0 |  |
| 2,0 |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 28 students are of the opinion that the weakening traditional school credentials is not important to consider as a challenge for the adoption of blockchain technologies in education; 28 students think it is little import to consider; 48 students think it is average import to consider; 20 students think it is important to consider; and 20 students think it is highly import to consider. Also, 6 students did not answer the question.

In Table 4.58 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint b (trust):

**Table 4.58: Frequency of question 8 – subpoint b**

##### Challenges of blockchain technologies - Trust

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 6 | 4,1 | 4,1 | 4,1 |
| 21 | 14,3 | 14,5 | 18,6 |
| 28 | 19,0 | 19,3 | 37,9 |
| 32 | 21,8 | 22,1 | 60,0 |
| 58 | 39,5 | 40,0 | 100,0 |
| 145 | 98,6 | 100,0 |  |
| Missing Total | 0 | 2  147 | 1,4 |  |  |
| 100,0 |  |

As can be seen, 6 students are of the opinion that trust is not important to consider as a challenge for the adoption of blockchain technologies in education; 21 students think it is little import to consider; 28 students think it is average import to consider; 32 students think it is import to consider; and 58 students think it is highly import to consider. Also, 2 students did not answer the question.

In Table 4.59 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint c (Privacy & security):

**Table 4.59: Frequency of question 8 – subpoint c**

##### Challenges of blockchain technologies - Privacy & Security

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 9 | 6,1 | 6,3 | 6,3 |
| 12 | 8,2  15,6 | 8,3 | 14,6 |
| 23 | 16,0 | 30,6 |
| 33 | 22,4 | 22,9 | 53,5 |
| 67 | 45,6 | 46,5 | 100,0 |
| 144 | 98,0 | 100,0 |  |
| Missing Total | 0 | 3  147 | 2,0 |  |  |
| 100,0 |  |

As can be seen, 9 students are of the opinion that privacy & security is not important to consider as a challenge for the adoption of blockchain technologies in education; 12 students think it is little import to consider; 23 students think it is average import to consider; 33 students think it is import to consider; and 67 students think it is highly import to consider. Also, 3 students did not answer the question.

In Table 4.60 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint d (Cost):

**Table 4.60: Frequency of question 8 – subpoint d**

##### Challenges of blockchain technologies - Cost

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 3 | 2,0 | 2,1 | 2,1 |
| 16 | 10,9 | 11,1 | 13,2 |
| 47 | 32,0 | 32,6 | 45,8 |
| 37 | 25,2 | 25,7 | 71,5 |
| 41 | 27,9 | 28,5 | 100,0 |
| 144 | 98,0 | 100,0 |  |
| Missing | 0 | 3 | 2,0 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 3 students are of the opinion that cost is not important to consider as a challenge for the adoption of blockchain technologies in education; 16 students think it is little import to consider; 47 students think it is average import to consider; 37 students think it is import to consider; and 41 students think it is highly import to consider. Also, 3 students did not answer the question.

In Table 4.61 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint e (Immutability):

**Table 4.61: Frequency of question 8 – subpoint e**

##### Challenges of blockchain technologies - Immutability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 6 | 4,1 | 4,3 | 4,3 |
| 17 | 11,6 | 12,1 | 16,3 |
| 59 | 40,1  25,2 | 41,8 | 58,2 |
| 37 | 26,2 | 84,4 |
| 22 | 15,0 | 15,6 | 100,0 |
| 141 | 95,9 | 100,0 |  |
| Missing | 0 | 6 | 4,1 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 6 students are of the opinion that immutability is not important to consider as a challenge for the adoption of blockchain technologies in education; 17 students think it is little import to consider; 59 students think it is average import to consider; 37 students think it is import to consider; and 22 students think it is highly import to consider. Also, 6 students did not answer the question.

In Table 4.62 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint f (Scalability):

**Table 4.62: Frequency of question 8 – subpoint f**

##### Challenges of blockchain technologies - Scalability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 6 | 4,1 | 4,2 | 4,2 |
| 16 | 10,9 | 11,3 | 15,5 |
| 43 | 29,3 | 30,3 | 45,8 |
| 40 | 27,2 | 28,2 | 73,9 |
| 37 | 25,2 | 26,1 | 100,0 |
| 142 | 96,6 | 100,0 |  |
| Missing | 0 | 5 | 3,4 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 6 students are of the opinion that scalability is not important to consider as a challenge for the adoption of blockchain technologies in education; 16 students think it is little import to consider; 43 students think it is average import to consider; 40 students think it is import to consider; and 37 students think it is highly import to consider. Also, 5 students did not answer the question.

In Table 4.63 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint g (Data unavailability):

**Table 4.63: Frequency of question 8 – subpoint g Challenges of blockchain technologies - Data unavailability**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider | 7 | 4,8 | 4,8 | 4,8 |
|  | Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 26 | 17,7 | 17,9 | 22,8 |
| 36 | 24,5  29,3 | 24,8 | 47,6 |
| 43 | 29,7 | 77,2 |
| 33 | 22,4 | 22,8 | 100,0 |
| 145 | 98,6 | 100,0 |  |
| Missing | 0 | 2 | 1,4 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 7 students are of the opinion that data unavailability is not important to consider as a challenge for the adoption of blockchain technologies in education; 26 students think it is little import to consider; 36 students think it is average import to consider; 43 students think it is import to consider; and 33 students think it is highly import to consider. Also, 2 students did not answer the question.

In Table 4.64 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint h (Setting the boundaries):

**Table 4.64: Frequency of question 8 – subpoint h**

##### Challenges of blockchain technologies - Setting the boundaries

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider  Total | 4 | 2,7 | 2,8 | 2,8 |
| 19 | 12,9 | 13,2 | 16,0 |
| 40 | 27,2 | 27,8 | 43,8 |
| 33 | 22,4 | 22,9 | 66,7 |
| 48 | 32,7 | 33,3 | 100,0 |
| 144 | 98,0 | 100,0 |  |
| Missing | 0 | 3 | 2,0 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 4 students are of the opinion that setting the boundaries is not important to consider as a challenge for the adoption of blockchain technologies in education; 19 students think it is little import to consider; 40 students think it is average import to consider; 33 students think it is import to consider; and 48 students think it is highly import to consider. Also, 3 students did not answer the question.

In Table 4.65 the frequency of answers to question 8 (Challenges of adopting blockchain technologies in education) subpoint i (Immaturity):

**Table 4.65: Frequency of question 8 – subpoint i**

##### Challenges of blockchain technologies - Immaturity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Not important to consider  Little important to consider  Average important to consider  Important to consider  Highly important to consider | 12 | 8,2  26,5 | 8,3 | 8,3 |
| 39 | 26,9 | 35,2 |
| 41 | 27,9 | 28,3 | 63,4 |
| 22 | 15,0 | 15,2 | 78,6 |
| 31 | 21,1 | 21,4 | 100,0 |
|  | Total | 145 | 98,6 | 100,0 |  |
| Missing | 0 | 2 | 1,4 |  |  |
| Total |  | 147 | 100,0 |  |  |

As can be seen, 12 students are of the opinion that immaturity is not important to consider as a challenge for the adoption of blockchain technologies in education; 39 students think it is little import to consider; 41 students think it is average import to consider; 22 students think it is import to consider; and 31 students think it is highly import to consider. Also, 2 students did not answer the question.

### 4.1.2. Interviews (for experts)

Considering the 7 interviews with experts, the following are mentioned:

* 3 experts are part of the public organization, and 4 of the private organization,
* 4 experts work in the field of education, 3 experts in the field of IT, and one in the field of ICT,
* 3 experts are in an executive position, and 4 in a manager position.

As potential blockchain applications in higher education, they mentioned:

* student records (including diplomas and certificates),
* file storage (including courses and curricula),
* blockchain in research (the researchers can publish the results and they can monitor their research’s reuse, including how often a work is cited and used as teaching materials),
* digital identity,
* adoption of crypto currency,
* knowledge and data sharing,
* monetization of the blockchain (in a research blockchain, tokens can be created and distributed among the publishers that they can resell),
* increasing efficiency in administrative processes (payments, smart contracts etc.),
* keeping track of all student grades throughout the years of study and beyond,
* intellectual property management,
* verifiable Credentials for university diplomas and micro-credentials,  funding tracking from higher level authorities,  payment for studies with a cryptocurrency.

As relevant data/learning units that may exist on the blockchain, they mention:

* smart contracts,
* security and the blockchain technology,
* information (no personal or sensitive data),
* the data related to the university activity,
* volunteer activity,
* awards and distinctions,
* ledgers, transactions and contracts,  assets.

As data quality assurance standards (to ensure that the data is accurate, verifiable and meaningful), they mention that the very concept of blockchain, as a decentralized database of transactions, shared and synchronized across multiple nodes, guarantees the quality of data.

Some of them also mention the following standards:

* ISO/TC 307/WG 2 - Security, privacy and identity,
* ISO/TC 307/WG 3 - Smart contracts and their applications,
* ISO/TC 307/WG 5 – Governance,
* ISO/TC 307/WG 6 - Blockchain Use cases,
* ISO/TC 307/WG 7 – Interoperability,
* DIN. 3104:2019-04 - Blockchain - Based Validation of Data,
* NISTIR 8202 - Blockchain Technology Overview,
* ISO/TR 23455:2019 - Blockchain and distributed ledger technologies.

Some reasons that experts mention in using the blockchain in education are: security and transparency, functionality, novelty, decentralization (unlike traditional database systems which store information on a central server), distributed and scalable, data immutability and integrity, accessibility and availability of data depending on users’ rights (authority), record-keeping uses such as digital credentials and intellectual property management, streamlining of diploma verification.

Most experts point out that there is no reason not to implement blockchain technology in education. Some of them mention some disadvantages, such as: the resources used for computational power and storage are really high and may have a negative impact on the environment; some Blockchain solutions consume too much energy; blockchain is not a distributed computing system.

Among the most important obstacles that higher education will have to overcome before the blockchain can be widely adopted, they mention:

* funding,
* lack of relevant experience or skill gap,
* lack of knowledge or understanding,
* legislative reglementation (each state has different laws that will need to regulate the usage and adoption) - EU’s General Data Protection Regulation (GDPR) may impose limitations on how personal data is transacted on the blockchain,
* market adoption (lack of trust in the technology and lack of knowledge on how to harness the potential of blockchain-in-education solutions may lead to a slow market adoption of such innovations).

With every new tech adoption that has broad implications, there are ―winners‖ and

―losers‖ who falls into these categories. Experts consider the winners as follows: high schools and the entire education system; banking system; health system; students; organizations that adopt blockchain technologies. Most also mention that they do not see losers. He also mentions that the governments should have clear politics in this field to ensure equity, access, and accessibility.

When asked " Is blockchain in higher education just hype?", most experts say they don't think so. It is mentioned that in order to go forward and take use of this technology, organizations need to start and implement multiple use cases for blockchain, even test them as prototypes to get the first conclusions and get peer reviewed.

As observation for blockchain adoption in Romania / Czech Republic / Norway / Iceland in general and in the education field in particular, they mention:

* the need for time to understand the benefits and the need for training,
* the existence of innovative startups and projects - which encourage the adoption of the blockchain in Romania,
* the blockchain landscape is evolving at a fast pace along with the whole IT&C industry and blockchain technology has been capturing the attention of more and more companies,
* despite there are not yet any specific national legislation, support and strategy for blockchain, Romania has a growing number of experienced companies, innovative startups and projects, active accelerators, many communities and events, and also numerous educational programs, initiatives and policy proposals.

When asked "How do you intend to check the relevant skills / competences when recruiting for a dedicated project / job linked to blockchain application in higher education (in Romania / Czech Republic / Norway / Iceland)?”, they mention:

* checking the knowledge in the field,
* the use of some systems with blockchain technology (if applicable),
* case studies (if applicable),
* education and previous experience,
* the existence of competencies such as: cloud computing, web development (backend and frontend) and experience working with highly scalable products,
* the existence of skills such as: Data Structure, Smart Contracts, Interoperability skills, Cryptography,
* portfolio of related work.

### 4.2. Statistical and logical analysis

Table 4.66 shows the main statistical indicators (Mean, Median, Mode, Variant, Skewness, Std. Error of Skewness, Kurtosis, Std. Error of Kurtosis) for the sub-items in question 4:

**Table 4.66: Statistical indicators - question 4**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Involvemen  t of  Governmen  t, strict  worldwide regulation | Everything has to be set up with opensource  technologie  s | The  ability to get a  copy of my own  data that can be stored on my own node, regardless of which blockchai n system was originally used | The  ability to operate a full node and store an encrypted copy of the blockchai n used to store credential s | Involving corporation s in the process of setting up  Blockchain  -  technologie s in the educational sector | In-depth education about blockchaintechnologies for ITprofessionals and administrativ e-officers in the educationalsector | The  possibility to process informatio n from various blockchain -systems | Clear and transparen t rules  about who  is  responsibl e for  payment of fees | Basic  information/educati on about blockchaintechnologies for all people involved in the educational sector |
| N Valid | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |
| Missin g | 16 | 15  3,83 | 15 | 17 | 17 | 16  4,33 | 17 | 18  4,54 | 16  4,39 |
| Mean | 3,15 | 4,11 | 3,93 | 3,31 | 3,94 |
| Median | 3,00 | 4,00 | 4,00 | 4,00 | 3,00 | 5,00 | 4,00 | 5,00 | 5,00 |
| Mode | 3 | 4 | 5 | 4 | 3 | 5 | 4 | 5 | 5 |
| Skewness | -,028 | -,682 | -,730 | -,785 | -,225 | -,977 | -,564 | -1,608 | -1,502 |
| Std. Error of  Skewness |  |  |  |  |
| ,212 | ,211 | ,211 | ,212 | ,212 | ,212 | ,212 | ,213 | ,212 |
| Kurtosis Std. Error of  Kurtosis | -,826  ,420 | -,232 | -,063 | ,285 | -,811 | -,223 | -,407 | 1,812 | 2,340 |
|  |  |  |  |  |  |  |  |
| ,419 | ,419 | ,422 | ,422 | ,420 | ,422 | ,423 | ,420 |

As can be seen, the highest average can be found in sub-point h (Clear and transparent rules about who is responsible for payment of fees). The mean is 4,54, which indicates that, on average, students consider clear and transparent rules about who is responsible for paying fees is one of the most important things to consider before including blockchain technologies in the education sector. It can be seen that for 4 sub-points from question 4 the median is equal to 4. This indicates that half of the students assigned values less than or equal to 4, and the other half assigned values greater than or equal to 4. The mode shows the most common value in student responses. It can be seen, students consider that the most important issues to consider before including blockchain technologies in the education sector are the ability to get a copy of my own data that can be stored on my own node, regardless of which blockchain system was originally used; in-depth education about blockchain-technologies for IT-professionals and administrative officers in the educational-sector; clear and transparent rules about who is responsible for payment of fees, and basic information/education about blockchain-technologies for all people involved in the educational sector. Regarding the value of Skewness, it can be seen that it is negative to all sub-points. This indicates an asymmetry with the left, i.e. respondents chose higher values. Kurtosis value is positive on sub-points d, h, i, which indicates that the values are close to average, with mostly lower values. In the other sub-points, the Kurtosis value is negative, which indicates that the values are far from average, with mostly high values.

Table 4.67 shows the main statistical indicators (Mean, Median, Mode, Variant, Skewness, Std. Error of Skewness, Kurtosis, Std. Error of Kurtosis) for the sub-items in question 5:

**Table 4.67: Statistical indicators - question 5**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Use in the education  al sector - Certificat es  managem  ent | Use in the educationa l sector -  Competen  cies and learning  outcomes  manageme  nt | Use in the education  al sector  -  Evaluatin g students’ professio nal ability | Use in the education  al sector - Securing collaborat ive  learning environm  ent | Use in the educatio nal sector - Protectin g learning objects | Use in the educatio nal  sector - Fees and credits transfer | Use in the education  al sector - Obtaining digital guardians hip consent | Use in the education  al sector - Copyright  s  managem  ent | Use in the educatio nal  sector - Enhanci ng students’ interacti ons in elearning | Use in the educatio nal  sector - Supporti ng lifelong learning | Use in the educationa l sector - Allowing employers and other organizati ons to view student’  educationa  l results and other qualificati ons on a blockchai n |
| N Valid | 133 | 132 | 133 | 132 | 133 | 133 | 132 | 132 | 133 | 130 | 131 |
| Missi ng | 14 | 15 | 14 | 15 | 14 | 14 | 15 | 15 | 14 | 17 | 16 |
| Mean | 3,83 | 3,43 | 3,13 | 3,77 | 3,80 | 4,02 | 3,70 | 3,99 | 3,65 | 3,60 | 3,36 |
| Median | 4,00 | 3,00 | 3,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 3,00 |
| Mode Skewnes  s  Std.  Error of  Skewnes  s | 5 | 3 | 3  -,015  ,210 | 4 | 4 | 5 | 3 | 5 | 5 | 4 | 5 |
| -,425 | -,074 | -,481 | -,449 | -,824 | -,357 | -,923 | -,404 | -,455 | -,284 |
|  |  |  |  |  |  |  |  |  |  |
| ,210 | ,211 | ,211 | ,210 | ,210 | ,211 | ,211 | ,210 | ,212 | ,212 |
| Kurtosis Std.  Error of  Kurtosis | -,817 | -,778 | -,864  ,417 | -,437 | -,715 | -,391 | -,686 | ,195 | -,823 | -,702 | -1,072 |
|  |  |  |  |  |  |  |  |  |  |
| ,417 | ,419 | ,419 | ,417 | ,417 | ,419 | ,419 | ,417 | ,422 | ,420 |

As can be seen, the highest average can be found in sub-point f (Fees and credits transfer). The mean is 4,02, which indicates that, on average, students consider blockchain technologies to be the most suitable for the transfer of taxes and credits. It can be seen that for 8 sub-points from question 5 the median is equal to 4. This indicates that half of the students assigned values less than or equal to 4, and the other half assigned values greater than or equal to 4. The mode shows the most common value in student responses. It can be seen that students consider blockchain technologies to be highly suitable for certificates management, fees and credits transfer, copyrights management, enhancing students’ interactions in e-learning, and allowing employers and other organizations to view students’ educational results and other qualifications on a blockchain. Regarding the value of Skewness, it can be seen that it is negative to all 11 subpoints. This indicates an asymmetry with the left, i.e. respondents chose higher values. Kurtosis value is positive on sub-point h, which indicates that the values are close to average, with mostly lower values. In the other sub-points, the Kurtosis value is negative, which indicates that the values are far from average, with mostly high values.

Table 4.68 shows the main statistical indicators (Mean, Median, Mode, Variant, Skewness, Std. Error of Skewness, Kurtosis, Std. Error of Kurtosis) for the sub-items in question 6:

**Table 4.68: Statistical indicators - question 6**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Teacher - Knowledge of blockchaintechnologiesi n the educational sector | Administrativ e IT-Officer - Knowledge of blockchaintechnologiesin the educational sector | Administrativ e Non-ITOfficer -  Knowledge of blockchaintechnologiesin the educational sector | Headmaster/Rector/Dea n - Knowledge of blockchaintechnologiesin the educational sector | Educational  App-  Developer - Knowledge of blockchaintechnologiesi n the educational sector | Researcher in the field of education and educational technologies - Knowledge of blockchaintechnologiesi n the educational sector | Hardware/Softwar  e Specialist - Knowledge of blockchaintechnologiesin the educational sector |
| N Valid | 130 | 132 | 131 | 131 | 131 | 132  15 | 132 |
| Missin g | 17 | 15 | 16 | 16 | 16 | 15 |
| Mean | 3,55 | 4,45 | 2,79 | 3,52 | 4,34 | 4,35 | 4,48 |
| Median | 4,00 | 5,00 | 3,00 | 3,00 | 4,00 | 5,00 | 5,00 |
| Mode | 5 | 5 | 2 | 3 | 5 | 5 | 5 |
| Skewness Std. Error of  Skewness | -,408 | -1,355 | ,348 | -,238 | -,969 | -1,209  ,211 | -1,656 |
|  |  |  |  |  |  |
| ,212 | ,211 | ,212 | ,212 | ,212 | ,211 |
| Kurtosis Std. Error of Kurtosis | -1,042 | 1,134 | -,494 | -,816 | ,362 | 1,193  ,419 | 2,465 |
| ,422 | ,419 | ,420 | ,420 | ,420 | ,419 |

As can be seen, the highest average can be found in sub-point g (Hardware/Software Specialist). The mean is 4,48, which indicates that, on average, students consider that hardware/software specialist needs more knowledge of blockchain technologies, in terms of their use in the education sector. It can be seen that for 3 sub-points from question 6 the median is equal to 5. This indicates that half of the students assigned values less than or equal to 5, and the other half assigned values equal to 5. The mode shows the most common value in student responses. As can be seen, students consider that as a teacher, administrative IT-Officer, educational App Developer, researcher in the field of education and educational technologies and hardware / software specialist requires greater knowledge of blockchain technologies, in terms of their use in the education sector. Regarding the value of Skewness, it can be seen that it is negative to 6 sub-points. This indicates an asymmetry with the left, ie respondents chose higher values. Kurtosis value is positive on sub-points b, e, f, g, which indicates that the values are close to average, with mostly lower values. In the other sub-points, the Kurtosis value is negative, which indicates that the values are far from average, with mostly high values.

Table 4.69 shows the main statistical indicators (Mean, Median, Mode, Variant, Skewness, Std. Error of Skewness, Kurtosis, Std. Error of Kurtosis) for the sub-items in question 7:

**Table 4.69: Statistical indicators - question 7**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Benefit of blockchain technologie  s -  Enhancing learners' activity | Benefit of blockchain technologie  s -  Supporting learners' career decisions | Benefit of blockchain technologie  s -  Improving  managemen t of student’s records | Benefit of blockchain technologie  s -  Enhancing  trust | Benefit of blockchain technologies - Identity authenticatio  n | Benefit of blockchain technologie s - Better control of data access | Benefit of blockchain technologie  s -  Enhancing students’ assessment | Benefit of blockchain technologie s - Low cost | Benefit of blockchain technologie s - High security |
| N Valid | 133 | 133  14  3,65 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |
| Missin g  Mean | 14 | 14 | 16  3,90 | 18 | 14 | 14  3,45 | 16  3,50 | 15 |
| 3,65 | 3,85 | 4,15 | 4,25 | 4,50 |
| Median | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 4,00 | 3,00 | 5,00 |
| Mode | 3 | 4 | 5 | 4a | 5 | 5 | 4 | 3 | 5 |
| Skewness Std. Error of  Skewness | -,449 | -,519  ,210 | -,763 | -,786  ,212 | -,851 | -1,147 | -,456 | -,040  ,212 | -1,924 |
|  |
| ,210 | ,210 | ,213 | ,210 | ,210 | ,211 |
| Kurtosis Std. Error of Kurtosis | -,307 | -,141  ,417 | -,036 | -,174  ,420 | -,305 | ,887 | -,310 | -1,112  ,420 | 3,198 |
| ,417 | ,417 | ,423 | ,417 | ,417 | ,419 |

As can be seen, the highest average can be found in sub-point i (High security). The mean is 4,50, which indicates that, on average, students consider that the most important benefit of adopting blockchain technologies in education is high security. It can be seen that for 7 subpoints from question 7 the median is equal to 4. This indicates that half of the students assigned values less than or equal to 4, and the other half assigned values greater than or equal to 4. The mode shows the most common value in student responses. As can be seen, students consider that the most important benefits of adopting blockchain technologies in education are improving management of student’s records, identity authentication, better control of data access, and high security. Regarding the value of Skewness, it can be seen that it is negative to all sub-points. This indicates an asymmetry with the left, ie respondents chose more high values. Kurtosis value is positive on sub-points f, i, which indicates that the values are close to average, with mostly lower values. In the other sub-points, the Kurtosis value is negative, which indicates that the values are far from average, with mostly high values.

Table 4.70 shows the main statistical indicators (Mean, Median, Mode, Variant, Skewness, Std. Error of Skewness, Kurtosis, Std. Error of Kurtosis) for the sub-items in question 8:

**Table 4.70: Statistical indicators - question 8**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Challenges of blockchain technologi es -  Weakening  traditional school credentials | Challenges of blockchain technologi es - Trust | Challenges of blockchain technologi es -  Privacy &  Security | Challenges of blockchain technologie  s -  Immutabilit y | Challenges of blockchain technologi es - Cost | Challenges of blockchain technologi es -  Scalability | Challenges of blockchain technologie s - Data unavailabilit y | Challenges of blockchain technologi es - Setting the boundaries | Challenges of blockchain technologi es -  Immaturity |
| N Valid | 144 | 145 | 144 | 141 | 144 | 142 | 145 | 144 | 145 |
| Missin g | 3  2,83 | 2  3,79 | 3 | 6 | 3 | 5 | 2  3,48 | 3  3,71 | 2 |
| Mean | 3,95 | 3,37 | 3,67 | 3,61 | 3,14 |
| Median | 3,00 | 4,00 | 4,00 | 3,00 | 4,00 | 4,00 | 4,00 | 4,00 | 3,00 |
| Mode | 3 | 5 | 5 | 3 | 3 | 3 | 4 | 5 | 3 |
| Skewness Std. Error | ,156  ,202  -,901  ,401 | -,619 | -,987 | -,145 | -,288 | -,409 | -,313 | -,397 | ,121 |
|  |  |  |
| of  Skewness | ,201  -,796 | ,202 | ,204 | ,202 | ,203 | ,201  -,842 | ,202  -,860 | ,201 |
| Kurtosis Std. Error | -,080 | -,277 | -,749 | -,547 | -1,076 |
|  |  |  |
| of Kurtosis | ,400 | ,401 | ,406 | ,401 | ,404 | ,400 | ,401 | ,400 |

As can be seen, the highest average can be found in sub-point c (Privacy & Security). The mean is 3,95, which indicates that, on average, students consider that the biggest challenge in adopting blockchain technologies in education is privacy and security. It can be seen that for 6 sub-points from question 8 the median is equal to 4. This indicates that half of the students assigned values less than or equal to 4, and the other half assigned values greater than or equal to 4. The mode shows the most common value in student responses. As can be seen, students consider to an average extent what the challenges in adopting blockchain technologies in education are weakening traditional school credentials, immutability, cost, scalability and immaturity. Regarding the value of Skewness, it can be seen that it is negative to 7 sub-points. This indicates an asymmetry with the left, ie respondents chose more high values. Kurtosis value is negative to all sub-points, which indicates that the values are far from average, with mostly high values.

*H1 - The use of blockchain technologies in the education sector influences the need for blockchain knowledge in different fields*

In order to be able to analyze H1, the 11 subpoints from question 5 (The level of use of blockchain technologies in different cases in the educational system) and the 7 subpoints from question 6 (The level of knowledge about blockchain technologies of different professions) will be taken into account. Table 4.71 shows the correlation between the variables of H1:

**Table 4.71: Correlations H1**

**Correlations**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Use in the  educat ional  sector  -  Certifi cates manag ement | Use in the  educati onal  sector -  Compe  tencies and  learnin g  outcom es  manag ement | Use in the  educa  tional  sector  -  Evalu ating  stude nts’  profes sional ability | Use in the  educat ional  sector  -  Securi ng  collab  orative learnin g  enviro nment | Use  in the educa  tional  sector  -  Prote cting  learni ng  objec ts | Use  in the educa  tional  sector  - Fees and  credit s  transf er | Use in the  educat ional  sector  -  Obtain ing  digital guardi  anship  conse nt | Use in the  educat ional  sector  -  Copyr ights manag ement | Use  in the educa  tional  sector  -  Enha  ncing stude nts’  intera  ctions in e-  learni ng | Use  in the educa  tional  sector  -  Supp  orting  lifelo ng  learni ng | Use in the  educati onal  sector  -  Allowi ng  emplo yers and  other organi  zations to  view  student  ’  educati onal  results and  other  qualifi  cations on a  blockc hain | Teache r -  Knowl  edge of blockc hain-  technol ogiesin the  educati onal sector | Admini  strative  IT-  Officer  -  Knowle dge of  blockch ain-  technol ogiesin the  educati onal sector | Admini  strative  Non-  IT-  Officer  -  Knowle dge of  blockch ain-  technol ogiesin the  educati onal sector | Headmaster/  Rector/Dean -  Knowledge  of  blockchain-  technologiesi n the  educational sector | Educati onal App-  Develo per -  Knowl  edge of blockc hain-  technol ogiesin the  educati onal sector | Resear cher in the  field of educati on and  educati onal  technol ogies -  Knowl  edge of blockc hain-  technol ogiesin the  educati onal sector | Hardware/  Software  Specialist  -  Knowledg e of  blockchai n-  technologi esin the  educationa l sector |
| Use in the educational sector - Certificates  management | Pears on Corre  lation | 1 | ,501\*\* | ,249\*\* | ,491\*\* | ,237\*\* | ,429\*\* | ,184\* | ,317\*\* | -,019 | ,157 | ,203\* | ,137 | ,204\* | ,159 | ,106 | ,183\* | ,158 | ,093 |
| Sig. (2tailed  ) |  | ,000 | ,004 | ,000 | ,006 | ,000 | ,035 | ,000 | ,830 | ,074 | ,020 | ,120 | ,019 | ,070 | ,228 | ,037 | ,071 | ,289 |
| N | 133 | 132 | 133 | 132 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 130 | 132 | 131 | 131 | 131 | 132 | 132 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Pears  Use in the on educational Corre sector - lation | | ,501\*\* | 1 | ,452\*\* | ,316\*\* | ,192\* | ,239\*\* | ,118 | ,103 | ,375\*\* | ,392\*\* | ,319\*\* | ,090 | ,157 | ,219\* | ,250\*\* | ,121 | ,249\*\* | ,267\*\* |
| Competencies and learning outcomes management | Sig. (2tailed  ) | ,000 |  | ,000 | ,000 | ,027 | ,006 | ,181 | ,241 | ,000 | ,000 | ,000 | ,313 | ,073 | ,012 | ,004 | ,170 | ,004 | ,002 |
| N | 132 | 132 | 132 | 131 | 132 | 132 | 131 | 131 | 132 | 129 | 130 | 129 | 131 | 130 | 130 | 130 | 131 | 132 |
| Use in the educational sector - Evaluating students’ professional ability | Pears on Corre  lation | ,249\*\* | ,452\*\* | 1 | ,410\*\* | ,208\* | ,126 | ,112 | ,190\* | ,325\*\* | ,378\*\* | ,268\*\* | ,199\* | ,218\* | ,386\*\* | ,376\*\* | ,185\* | ,204\* | ,157 |
| Sig. (2tailed  ) | ,004 | ,000 |  | ,000 | ,016 | ,149 | ,200 | ,029 | ,000 | ,000 | ,002 | ,023 | ,012 | ,000 | ,000 | ,034 | ,019 | ,073 |
| N | 133 | 132 | 133 | 132 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 130 | 132 | 131 | 131 | 131 | 132 | 132 |
| Use in the educational sector - Securing collaborative learning environment | Pears on Corre  lation | ,491\*\* | ,316\*\* | ,410\*\* | 1 | ,405\*\* | ,309\*\* | ,247\*\* | ,290\*\* | ,139 | ,206\* | ,188\* | ,158 | ,201\* | ,159 | ,154 | ,164 | ,118 | ,075 |
| Sig. (2tailed  )  N | ,000 | ,000  131 | ,000  132 |  | ,000 | ,000  132 | ,004 | ,001  131 | ,112 | ,019 | ,032 | ,075  129 | ,021 | ,070 | ,081 | ,061  130 | ,181 | ,397  131 |
| 132 | 132 | 132 | 131 | 132 | 129 | 130 | 131 | 130 | 130 | 131 |
| Use in the educational sector - Protecting learning objects | Pears on Corre  lation | ,237\*\* | ,192\* | ,208\* | ,405\*\* | 1 | ,347\*\* | ,333\*\* | ,364\*\* | ,263\*\* | ,282\*\* | ,138 | ,098 | ,113 | ,087 | ,043 | ,224\* | ,270\*\* | ,219\* |
| Sig. (2tailed  )  N | ,006 | ,027  132 | ,016  133 | ,000 |  | ,000  133 | ,000 | ,000  132 | ,002 | ,001 | ,117 | ,268  130 | ,196 | ,325 | ,628 | ,010  131 | ,002 | ,012  132 |
| 133 | 132 | 133 | 132 | 133 | 130 | 131 | 132 | 131 | 131 | 132 |
| Use in the educational sector - Fees and credits | Pears on Corre  lation | ,429\*\* | ,239\*\* | ,126 | ,309\*\* | ,347\*\* | 1 | ,411\*\* | ,390\*\* | ,121 | ,118 | ,189\* | ,193\* | ,057 | -,009 | ,053 | ,229\*\* | ,145 | -,007 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| transfer | Sig. (2tailed  ) | ,000 | ,006 | ,149 | ,000 | ,000 |  | ,000 | ,000 | ,164 | ,181 | ,030 | ,028 | ,518 | ,923 | ,545 | ,009 | ,097 | ,933 |
| N | 133 | 132 | 133 | 132 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 130 | 132 | 131 | 131 | 131 | 132 | 132 |
| Use in the educational  sector -  Obtaining digital guardianship consent | Pears on Corre  lation Sig. (2tailed  ) | ,184\* | ,118  ,181 | ,112  ,200 | ,247\*\* | ,333\*\* | ,411\*\*  ,000 | 1 | ,463\*\*  ,000 | ,077 | ,020 | ,151 | ,125  ,158 | ,047 | -,022 | ,031 | ,275\*\*  ,002 | ,201\* | ,171  ,051 |
| ,035 | ,004 | ,000 |  | ,377 | ,821 | ,086 | ,593 | ,805 | ,730 | ,021 |
| N | 132 | 131 | 132 | 131 | 132 | 132 | 132 | 131 | 132 | 129 | 130 | 129 | 131 | 130 | 130 | 130 | 131 | 131 |
| Use in the educational sector -  Copyrights management | Pears on Corre  lation Sig. (2tailed  ) | ,317\*\* | ,103  ,241 | ,190\*  ,029 | ,290\*\* | ,364\*\* | ,390\*\*  ,000 | ,463\*\* | 1 | ,110 | ,108 | ,078 | ,207\*  ,019 | ,259\*\* | ,142 | ,213\* | ,354\*\*  ,000 | ,158 | ,079  ,371 |
| ,000 | ,001 | ,000 | ,000 | ,210 | ,224 | ,376 | ,003 | ,107 | ,015 | ,072 |
| N | 132 | 131 | 132 | 131 | 132 | 132 | 131 | 132 | 132 | 129 | 130 | 129 | 131 | 130 | 130 | 130 | 131 | 131 |
| Use in the educational sector -  Enhancing students’ interactions in e-learning | Pears on Corre  lation Sig. (2tailed  ) | -,019 | ,375\*\*  ,000 | ,325\*\*  ,000 | ,139 | ,263\*\* | ,121  ,164 | ,077 | ,110  ,210 | 1 | ,656\*\* | ,297\*\* | ,221\*  ,011 | ,224\*\* | ,305\*\* | ,324\*\* | ,030  ,737 | ,240\*\* | ,133  ,130 |
| ,830 | ,112 | ,002 | ,377 |  | ,000 | ,001 | ,010 | ,000 | ,000 | ,006 |
| N | 133 | 132 | 133 | 132 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 130 | 132 | 131 | 131 | 131 | 132 | 132 |
| Pears on Use in the Corre  educational lation  sector -  Sig.  Supporting  (2lifelong tailed learning  ) | | ,157 | ,392\*\*  ,000 | ,378\*\*  ,000 | ,206\* | ,282\*\* | ,118  ,181 | ,020 | ,108  ,224 | ,656\*\* | 1 | ,217\* | ,132  ,138 | ,143 | ,280\*\* | ,226\* | ,009  ,915 | ,158 | -,030  ,733 |
| ,074 | ,019 | ,001 | ,821 | ,000 |  | ,013 | ,104 | ,001 | ,010 | ,073 |
| N | | 130 | 129 | 130 | 129 | 130 | 130 | 129 | 129 | 130 | 130 | 130 | 128 | 130 | 129 | 129 | 129 | 130 | 129 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use in the educational  sector - Allowing employers and other organizations to view student’ educational results and other qualifications on a blockchain | Pears on Corre  lation | ,203\* | ,319\*\* | ,268\*\* | ,188\* | ,138 | ,189\* | ,151 | ,078 | ,297\*\* | ,217\* | 1 | ,197\* | ,218\* | ,226\*\* | ,168 | ,019 | ,137 | ,010 |
| Sig. (2tailed  ) | ,020 | ,000 | ,002 | ,032 | ,117 | ,030 | ,086 | ,376 | ,001 | ,013 |  | ,026 | ,013 | ,010 | ,056 | ,834 | ,118 | ,911 |
| N | 131 | 130 | 131 | 130 | 131 | 131 | 130 | 130 | 131 | 130 | 131 | 129 | 131 | 130 | 130 | 130 | 131 | 130 |
| Teacher - Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,137 | ,090 | ,199\* | ,158 | ,098 | ,193\* | ,125 | ,207\* | ,221\* | ,132 | ,197\* | 1 | ,298\*\* | ,330\*\* | ,317\*\* | ,091 | ,149 | ,002 |
| Sig. (2tailed  ) | ,120 | ,313 | ,023 | ,075 | ,268 | ,028 | ,158 | ,019 | ,011 | ,138 | ,026 |  | ,001 | ,000 | ,000 | ,307 | ,090 | ,980 |
| N | 130 | 129 | 130 | 129 | 130 | 130 | 129 | 129 | 130 | 128 | 129 | 130 | 130 | 129 | 129 | 129 | 130 | 129 |
| Administrativ e IT-Officer - Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,204\* | ,157 | ,218\* | ,201\* | ,113 | ,057 | ,047 | ,259\*\* | ,224\*\* | ,143 | ,218\* | ,298\*\* | 1 | ,274\*\* | ,237\*\* | ,203\* | ,120 | ,192\* |
| Sig. (2tailed  )  N | ,019 | ,073  131 | ,012  132 | ,021 | ,196 | ,518  132 | ,593 | ,003  131 | ,010 | ,104 | ,013 | ,001  130 |  | ,002 | ,006 | ,020  131 | ,171 | ,028  131 |
| 132 | 131 | 132 | 131 | 132 | 130 | 131 | 132 | 131 | 131 | 132 |
| Administrativ e Non-ITOfficer -  Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,159 | ,219\* | ,386\*\* | ,159 | ,087 | -,009 | -,022 | ,142 | ,305\*\* | ,280\*\* | ,226\*\* | ,330\*\* | ,274\*\* | 1 | ,526\*\* | ,105 | ,136 | ,044 |
| Sig. (2tailed  ) | ,070 | ,012 | ,000 | ,070 | ,325 | ,923 | ,805 | ,107 | ,000 | ,001 | ,010 | ,000 | ,002 |  | ,000 | ,233 | ,120 | ,621 |
| N | 131 | 130 | 131 | 130 | 131 | 131 | 130 | 130 | 131 | 129 | 130 | 129 | 131 | 131 | 130 | 130 | 131 | 130 |
| Headmaster/R ector/Dean - Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,106 | ,250\*\* | ,376\*\* | ,154 | ,043 | ,053 | ,031 | ,213\* | ,324\*\* | ,226\* | ,168 | ,317\*\* | ,237\*\* | ,526\*\* | 1 | ,242\*\* | ,242\*\* | ,106 |
| Sig. (2tailed  ) | ,228 | ,004 | ,000 | ,081 | ,628 | ,545 | ,730 | ,015 | ,000 | ,010 | ,056 | ,000 | ,006 | ,000 |  | ,005 | ,005 | ,229 |
| N | 131 | 130 | 131 | 130 | 131 | 131 | 130 | 130 | 131 | 129 | 130 | 129 | 131 | 130 | 131 | 130 | 131 | 130 |
| Educational  App-  Developer - Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,183\* | ,121 | ,185\* | ,164 | ,224\* | ,229\*\* | ,275\*\* | ,354\*\* | ,030 | ,009 | ,019 | ,091 | ,203\* | ,105 | ,242\*\* | 1 | ,403\*\* | ,390\*\* |
| Sig. (2tailed  ) | ,037 | ,170 | ,034 | ,061 | ,010 | ,009 | ,002 | ,000 | ,737 | ,915 | ,834 | ,307 | ,020 | ,233 | ,005 |  | ,000 | ,000 |
| N | 131 | 130 | 131 | 130 | 131 | 131 | 130 | 130 | 131 | 129 | 130 | 129 | 131 | 130 | 130 | 131 | 131 | 130 |
| Researcher in the field of education and educational technologies - Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,158 | ,249\*\* | ,204\* | ,118 | ,270\*\* | ,145 | ,201\* | ,158 | ,240\*\* | ,158 | ,137 | ,149 | ,120 | ,136 | ,242\*\* | ,403\*\* | 1 | ,370\*\* |
| Sig. (2tailed  )  N | ,071 | ,004  131 | ,019  132 | ,181 | ,002 | ,097  132 | ,021 | ,072  131 | ,006 | ,073 | ,118 | ,090  130 | ,171 | ,120 | ,005 | ,000  131 |  | ,000  131 |
| 132 | 131 | 132 | 131 | 132 | 130 | 131 | 132 | 131 | 131 | 132 |
| Hardware/Sof tware  Specialist -  Knowledge of blockchaintechnologiesi n the educational sector | Pears on Corre  lation | ,093 | ,267\*\* | ,157 | ,075 | ,219\* | -,007 | ,171 | ,079 | ,133 | -,030 | ,010 | ,002 | ,192\* | ,044 | ,106 | ,390\*\* | ,370\*\* | 1 |
| Sig. (2tailed  ) | ,289 | ,002 | ,073 | ,397 | ,012 | ,933 | ,051 | ,371 | ,130 | ,733 | ,911 | ,980 | ,028 | ,621 | ,229 | ,000 | ,000 |  |
| N | 132 | 132 | 132 | 131 | 132 | 132 | 131 | 131 | 132 | 129 | 130 | 129 | 131 | 130 | 130 | 130 | 131 | 132 |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,019 and R = 0,204), between the use of blockchain technologies for certificate management and the need for high knowledge of the IT administrative officer. From this correlation it can be seen that an increase in the use of blockchain technologies for certificate management may lead to a small increase in the need for high knowledge of the IT administrative officer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,037 and R = 0,183), between the use of blockchain technologies for certificate management and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for certificate management may lead to a small increase in the need for high knowledge of the educational app-developer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,012 and R = 0,219), between the use of blockchain technologies for competencies and learning outcomes management and the need for high knowledge of the administrative non-it-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to a small increase in the need for high knowledge of the administrative non-it-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,004 and R = 0,250), between the use of blockchain technologies for competencies and learning outcomes management and the need for high knowledge of the headmaster/rector/decan. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management can lead to an increase in the need for high knowledge of the headmaster/rector/decan.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,004 and R = 0,249), between the use of blockchain technologies for competencies and learning outcomes management and the need for high knowledge of the researcher in the field of education and educational technologies. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management can lead to an increase in the need for high knowledge of the researcher in the field of education and educational technologies.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,267), between the use of blockchain technologies for competencies and learning outcomes management and the need for high knowledge of the hardware/software specialist. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management can lead to an increase in the need for high knowledge of the hardware/software specialist.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,023 and R = 0,199), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the teacher. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability may lead to a small increase in the need for high knowledge of the teacher.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,012 and R = 0,218), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the administrative IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability may lead to a small increase in the need for high knowledge of the administrative IT-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,000.. and R = 0,386), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the administrative non-IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability can lead to an increase in the need for high knowledge of the administrative non-IT-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,000.. and R = 0,376), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the headmaster/rector/decan. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability can lead to an increase in the need for high knowledge of the headmaster/rector/decan.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,034 and R = 0,185), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability may lead to a small increase in the need for high knowledge of the educational app-developer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,019 and R = 0,204), between the use of blockchain technologies for evaluating students’ professional ability and the need for high knowledge of the researcher in the field of education and educational technologies. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ professional ability may lead to a small increase in the need for high knowledge of the researcher in the field of education and educational technologies.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,021 and R = 0,201), between the use of blockchain technologies for securing collaborative learning environment and the need for high knowledge of the administrative IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for securing collaborative learning environment may lead to a small increase in the need for high knowledge of the administrative IT-officer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,010 and R = 0,224), between the use of blockchain technologies for protecting learning objects and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for for protecting learning objects may lead to a small increase in the need for high knowledge of the educational app-developer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,270), between the use of blockchain technologies for protecting learning objects and the need for high knowledge of the researcher in the field of education and educational technologies. From this correlation it can be seen that an increase in the use of blockchain technologies for protecting learning objects can lead to an increase in the need for high knowledge of the researcher in the field of education and educational technologies.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,012 and R = 0,219), between the use of blockchain technologies for protecting learning objects and the need for high knowledge of the hardware/software specialist. From this correlation it can be seen that an increase in the use of blockchain technologies for for protecting learning objects may lead to a small increase in the need for high knowledge of the hardware/software specialist.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,028 and R = 0,193), between the use of blockchain technologies for fees and credits transfer and the need for high knowledge of the teacher. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to a small increase in the need for high knowledge of the teacher.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,009 and R = 0,229), between the use of blockchain technologies for fees and credits transfer and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer can lead to an increase in the need for high knowledge of the educational app-developer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,275), between the use of blockchain technologies for obtaining digital guardianship consent and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent can lead to an increase in the need for high knowledge of the educational app-developer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,021 and R = 0,201), between the use of blockchain technologies for obtaining digital guardianship consent and the need for high knowledge of the researcher in the field of education and educational technologies. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent may lead to a small increase in the need for high knowledge of the researcher in the field of education and educational technologies.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,019 and R = 0,207), between the use of blockchain technologies for copyrights management and the need for high knowledge of the teacher. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to a small increase in the need for high knowledge of the teacher.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,259), between the use of blockchain technologies for copyrights management and the need for high knowledge of the administrative IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management can lead to an increase in the need for high knowledge of the administrative IT-officer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,015 and R = 0,213), between the use of blockchain technologies for copyrights management and the need for high knowledge of the headmaster/rector/decan. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to a small increase in the need for high knowledge of the headmaster/rector/decan.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,354), between the use of blockchain technologies for copyrights management and the need for high knowledge of the educational app-developer. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management can lead to an increase in the need for high knowledge of the educational app-developer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,011 and R = 0,221), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need for high knowledge of the teacher. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to a small increase in the need for high knowledge of the teacher.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,010 and R = 0,224), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need for high knowledge of the administrative IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning can lead to an increase in the need for high knowledge of the administrative IT-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,305), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need for high knowledge of the administrative non-IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning can lead to an increase in the need for high knowledge of the administrative non-IT-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,000.. and R = 0,324), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need for high knowledge of the headmaster/rector/decan. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning can lead to an increase in the need for high knowledge of the headmaster/rector/decan.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,006 and R = 0,240), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need for high knowledge of the researcher in the field of education and educational technologies. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning can lead to an increase in the need for high knowledge of the researcher in the field of education and educational technologies.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,280), between the use of blockchain technologies for supporting lifelong learning and the need for high knowledge of the administrative non-IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for supporting lifelong learning can lead to an increase in the need for high knowledge of the administrative non-IT-officer.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,010 and R = 0,226), between the use of blockchain technologies for supporting lifelong learning and the need for high knowledge of the headmaster/rector/decan. From this correlation it can be seen that an increase in the use of blockchain technologies for supporting lifelong learning may lead to a small increase in the need for high knowledge of the headmaster/rector/decan.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,026 and R = 0,197), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need for high knowledge of the teacher. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need for high knowledge of the teacher.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,013 and R = 0,218), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need for high knowledge of the administrative IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need for high knowledge of the administrative IT-officer.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,010 and R = 0,226), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need for high knowledge of the administrative non-IT-officer. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain can lead to an increase in the need for high knowledge of the administrative non-IT-officer.

*H2 - Issues to consider before including blockchain technologies in the education sector influence the use of blockchain technologies*

In order to be able to analyze H2, the 11 subpoints from question 5 (The level of use of blockchain technologies in different cases in the educational system) and the 9 subpoints from question 4 (Issues to consider before including blockchain technologies in the education sector) will be taken into account. Table 4.72 shows the correlation between the variables of H2:

**Table 4.72: Correlations H2**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Use in the  educat ional  sector  -  Certifi cates manag ement | Use in the  educati onal  sector -  Compe  tencies and  learnin g  outcom es  manag ement | Use  in the educa  tional  sector  -  Evalu ating  stude nts’  profes sional  abilit y | Use in the  educat ional  sector  -  Securi ng  collab  orativ e  learni ng  enviro nment | Use  in the educa  tional secto r -  Prote cting  learni ng  objec ts | Use  in the educa  tional secto r -  Fees and  credit s  transf er | Use in the  educat ional  sector  -  Obtai ning  digital guardi  anship  conse nt | Use in the  educat ional  sector  -  Copyr ights manag ement | Use  in the educa  tional  sector  -  Enha  ncing stude nts’  intera  ctions in e-  learni ng | Use  in the educa  tional secto r -  Supp ortin g  lifelo ng  learni ng | Use in the  educat ional  sector  -  Allowi ng  emplo yers and  other organi  zations to  view  studen t’  educat ional  results and  other  qualifi  cations on a  blockc hain | Involv ement of  Gover nment, strict  world wide regula tion | Every thing  has to  be set up  with open-  source techn  ologie s | The abilit y to  get a copy of  my  own data that can be  store d on my  own  node, regar dless of  whic h  block chain  syste m  was  origi  nally used | The abilit y to  opera te a full  node and  store an  encry pted  copy of  the  block chain used to  store  crede  ntials | Involv ing  corpor ations in the  proces s of  settin g up Block chaintechn  ologie s in the  educat ional sector | Indepth  educati on  about  blockch ain-  technol ogies  for IT-  professi onals and  adminis trative-  officers in the  educati onalsector | The possi  bility to  proce ss  infor  matio n  from  vario us  block  chain  syste ms | Clear and trans  paren t  rules  about who is  respo nsibl e for  paym  ent of fees | Basic information  /education about  blockchaintechnologie s for all  people  involved in the  educational sector |
| Use in the educational sector - Certificates  managemen  t | Pears on Corre  lation | 1 | ,501\*\* | ,249\*\* | ,491\*\*  ,000  132 | ,237\*\* | ,429\*\* | ,184\* | ,317\*\* | -,019 | ,157 | ,203\* | ,082 | -,013 | ,301\*\* | ,285\*\* | ,121 | ,159 | ,109 | ,156 | ,320\*\* |
| Sig. (2tailed  ) |  | ,000 | ,004 | ,006 | ,000 | ,035 | ,000 | ,830 | ,074 | ,020 | ,354 | ,878 | ,000 | ,001 | ,169 | ,070 | ,219 | ,078 | ,000 |
| N | 133 | 132 | 133 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Use in the Pears educational on sector - Corre Competenci lation | | ,501\*\* | 1 | ,452\*\* | ,316\*\*  ,000  131 | ,192\* | ,239\*\* | ,118 | ,103 | ,375\*\* | ,392\*\* | ,319\*\* | ,163 | ,171 | ,196\* | ,289\*\* | ,308\*\* | ,091 | ,248\*\* | ,135 | ,353\*\* |
| es and Sig. learning (2outcomes tailed managemen ) | | ,000 |  | ,000 | ,027 | ,006 | ,181 | ,241 | ,000 | ,000 | ,000 | ,063 | ,051 | ,025 | ,001 | ,000 | ,306 | ,005 | ,128 | ,000 |
| t N | | 132 | 132 | 132 | 132 | 132 | 131 | 131 | 132 | 129 | 130 | 130 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 130 |
| Pears  Use in the on educational Corre sector - lation | | ,249\*\* | ,452\*\* | 1 | ,410\*\*  ,000  132 | ,208\* | ,126 | ,112 | ,190\* | ,325\*\* | ,378\*\* | ,268\*\* | ,110 | ,168 | ,218\* | ,162 | ,285\*\* | ,130 | ,285\*\* | ,193\* | ,205\* |
| Evaluating Sig.  students’ (2-  professional tailed  ability ) | | ,004 | ,000 |  | ,016 | ,149 | ,200 | ,029 | ,000 | ,000 | ,002 | ,209 | ,054 | ,012 | ,066 | ,001 | ,138 | ,001 | ,029 | ,019 |
|  | N | 133 | 132 | 133 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |
| Use in the educational sector - Securing collaborativ e learning  environmen  t | Pears on Corre  lation | ,491\*\* | ,316\*\* | ,410\*\* | 1    132 | ,405\*\* | ,309\*\* | ,247\*\* | ,290\*\* | ,139 | ,206\* | ,188\* | ,060 | ,114 | ,254\*\* | ,352\*\* | ,048 | ,154 | ,185\* | ,046 | ,273\*\* |
| Sig. (2tailed  )  N | ,000 | ,000 | ,000  132 | ,000  132 | ,000 | ,004 | ,001 | ,112 | ,019  129 | ,032  130 | ,499  130 | ,196 | ,003 | ,000 | ,589 | ,081  130 | ,036  129 | ,606 | ,002  130 |
| 132 | 131 | 132 | 131 | 131 | 132 | 131 | 131 | 129 | 129 | 128 |
| Use in the educational sector - Protecting learning objects | Pears on Corre  lation | ,237\*\* | ,192\* | ,208\* | ,405\*\*  ,000  132 | 1 | ,347\*\* | ,333\*\* | ,364\*\* | ,263\*\* | ,282\*\* | ,138 | ,035 | ,205\* | ,132 | ,276\*\* | ,122 | ,031 | ,234\*\* | ,060 | ,225\*\* |
| Sig. (2tailed  )  N | ,006 | ,027 | ,016  133 | 133 | ,000 | ,000 | ,000 | ,002 | ,001  130 | ,117  131 | ,689  131 | ,018 | ,131 | ,001 | ,165 | ,724  131 | ,007  130 | ,496 | ,010  131 |
| 133 | 132 | 133 | 132 | 132 | 133 | 132 | 132 | 130 | 130 | 129 |
| Use in the educational sector - Fees and | Pears on Corre  lation | ,429\*\* | ,239\*\* | ,126 | ,309\*\* | ,347\*\* | 1 | ,411\*\* | ,390\*\* | ,121 | ,118 | ,189\* | ,068 | ,073 | ,246\*\* | ,361\*\* | ,079 | ,266\*\* | ,262\*\* | ,195\* | ,378\*\* |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| credits transfer | Sig. (2tailed  ) | ,000 | ,006 | ,149 | ,000  132 | ,000 |  | ,000 | ,000 | ,164 | ,181 | ,030 | ,442 | ,404 | ,005 | ,000 | ,374 | ,002 | ,003 | ,027 | ,000 |
| N | 133 | 132 | 133 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |
| Use in the educational  sector -  Obtaining digital guardianshi p consent | Pears on Corre  lation Sig. (2tailed  ) | ,184\* | ,118 | ,112  ,200 | ,247\*\*  ,004  131 | ,333\*\*  ,000 | ,411\*\* | 1 | ,463\*\* | ,077 | ,020  ,821 | ,151  ,086 | ,051  ,562 | ,087 | ,208\* | ,286\*\* | -,015 | ,232\*\*  ,008 | ,289\*\*  ,001 | ,104 | ,143  ,105 |
| ,035 | ,181 | ,000 |  | ,000 | ,377 | ,323 | ,017 | ,001 | ,868 | ,242 |
| N | 132 | 131 | 132 | 132 | 132 | 132 | 131 | 132 | 129 | 130 | 130 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 130 |
| Use in the educational sector -  Copyrights managemen  t | Pears on Corre  lation Sig. (2tailed  ) | ,317\*\* | ,103 | ,190\*  ,029 | ,290\*\*  ,001  131 | ,364\*\*  ,000 | ,390\*\* | ,463\*\* | 1 | ,110 | ,108  ,224 | ,078  ,376 | ,081  ,357 | ,040 | ,147 | ,381\*\* | -,009 | ,230\*\*  ,008 | ,302\*\*  ,001 | ,122 | ,272\*\*  ,002 |
| ,000 | ,241 | ,000 | ,000 |  | ,210 | ,646 | ,094 | ,000 | ,923 | ,169 |
| N | 132 | 131 | 132 | 132 | 132 | 131 | 132 | 132 | 129 | 130 | 130 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 130 |
| Use in the educational sector -  Enhancing students’ interactions in elearning | Pears on Corre  lation Sig. (2tailed  ) | -,019 | ,375\*\* | ,325\*\*  ,000 | ,139  ,112  132 | ,263\*\*  ,002 | ,121 | ,077 | ,110 | 1 | ,656\*\*  ,000 | ,297\*\*  ,001 | ,114  ,194 | ,223\* | ,088 | ,199\* | ,313\*\* | ,148  ,091 | ,299\*\*  ,001 | ,073 | ,204\*  ,020 |
| ,830 | ,000 | ,164 | ,377 | ,210 |  | ,010 | ,316 | ,023 | ,000 | ,412 |
| N | 133 | 132 | 133 | 133 | 133 | 132 | 132 | 133 | 130 | 131 | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |
| Use in the educational sector -  Supporting lifelong learning | Pears on Corre  lation Sig. (2tailed  ) | ,157 | ,392\*\* | ,378\*\*  ,000 | ,206\*  ,019  129 | ,282\*\*  ,001 | ,118 | ,020 | ,108 | ,656\*\* | 1 | ,217\*  ,013 | ,090  ,310 | ,229\*\* | ,096 | ,140 | ,345\*\* | ,170  ,055 | ,164  ,065 | ,065 | ,198\*  ,025 |
| ,074 | ,000 | ,181 | ,821 | ,224 | ,000 | ,009 | ,279 | ,116 | ,000 | ,471 |
| N | 130 | 129 | 130 | 130 | 130 | 129 | 129 | 130 | 130 | 130 | 128 | 129 | 129 | 127 | 127 | 128 | 127 | 126 | 128 |

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| Use in the educational  sector - Allowing employers and other organizatio ns to view student’ educational results and other qualificatio ns on a blockchain | Pears on Corre  lation | ,203\* | ,319\*\* | ,268\*\* | ,188\*  ,032  130 | ,138 | ,189\* | ,151 | ,078 | ,297\*\* | ,217\* | 1 | ,168 | ,257\*\* | ,195\* | ,171 | ,215\* | ,213\* | ,262\*\* | ,102 | ,205\* |
| Sig. (2tailed  ) | ,020 | ,000 | ,002 | ,117 | ,030 | ,086 | ,376 | ,001 | ,013 |  | ,058 | ,003 | ,026 | ,054 | ,015 | ,016 | ,003 | ,253 | ,020 |
| N | 131 | 130 | 131 | 131 | 131 | 130 | 130 | 131 | 130 | 131 | 129 | 130 | 130 | 128 | 128 | 129 | 128 | 127 | 129 |
| Involvemen  t of  Governmen  t, strict  worldwide regulation | Pears on Corre  lation | ,082 | ,163 | ,110 | ,060  ,499  130 | ,035 | ,068 | ,051 | ,081 | ,114 | ,090 | ,168 | 1 | -,061 | ,085 | ,083 | ,170 | ,140 | ,179\* | ,065 | -,120 |
| Sig. (2tailed  ) | ,354 | ,063 | ,209 | ,689 | ,442 | ,562 | ,357 | ,194 | ,310 | ,058 |  | ,490 | ,334 | ,349 | ,054 | ,111 | ,042 | ,467 | ,173 |
| N | 131 | 130 | 131 | 131 | 131 | 130 | 130 | 131 | 128 | 129 | 131 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 130 |
| Everything has to be set up with open-source  technologie  s | Pears on Corre  lation | -,013 | ,171 | ,168 | ,114  ,196  131 | ,205\* | ,073 | ,087 | ,040 | ,223\* | ,229\*\* | ,257\*\* | -,061 | 1 | ,253\*\* | ,233\*\* | ,014 | ,052 | ,114 | ,008 | ,075 |
| Sig. (2tailed  )  N | ,878 | ,051 | ,054  132 | ,018  132 | ,404 | ,323 | ,646 | ,010 | ,009  129 | ,003  130 | ,490  131 |  | ,003 | ,008 | ,872 | ,555  131 | ,197  130 | ,932 | ,392  131 |
| 132 | 131 | 132 | 131 | 131 | 132 | 132 | 132 | 130 | 130 | 129 |
| The ability Pears to get a on copy of my Corre own data lation | | ,301\*\* | ,196\* | ,218\* | ,254\*\*  ,003 | ,132 | ,246\*\* | ,208\* | ,147 | ,088 | ,096 | ,195\* | ,085 | ,253\*\* | 1 | ,422\*\* | ,019 | ,251\*\* | ,220\* | ,125 | ,133 |
| that can be Sig. stored on (2my own tailed node, ) | | ,000 | ,025 | ,012 | ,131 | ,005 | ,017 | ,094 | ,316 | ,279 | ,026 | ,334 | ,003 |  | ,000 | ,832 | ,004 | ,012 | ,157 | ,129 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| regardless of which blockchain system was originally used | | N | 132 | 131 | 132 | 131 | 132 | 132 | 131 | 131 | 132 | 129 | 130 | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 |
| The ability to operate a full node and store an encrypted copy of the blockchain used to store credentials | | Pears on Corre  lation | ,285\*\* | ,289\*\* | ,162 | ,352\*\*  ,000  129 | ,276\*\* | ,361\*\* | ,286\*\* | ,381\*\* | ,199\* | ,140 | ,171 | ,083 | ,233\*\* | ,422\*\* | 1 | ,120 | ,315\*\* | ,395\*\* | ,124 | ,172 |
| Sig. (2tailed  ) | ,001 | ,001 | ,066 | ,001 | ,000 | ,001 | ,000 | ,023 | ,116 | ,054 | ,349 | ,008 | ,000 |  | ,174 | ,000 | ,000 | ,164 | ,052 |
| N | 130 | 129 | 130 | 130 | 130 | 129 | 129 | 130 | 127 | 128 | 129 | 130 | 130 | 130 | 130 | 129 | 128 | 127 | 129 |
| Involving corporation s in the process of setting up Blockchaintechnologie s in the educational sector | | Pears on Corre  lation Sig. (2tailed  ) | ,121 | ,308\*\* | ,285\*\*  ,001 | ,048  ,589  129 | ,122  ,165 | ,079 | -,015 | -,009 | ,313\*\* | ,345\*\*  ,000 | ,215\*  ,015 | ,170  ,054 | ,014 | ,019 | ,120 | 1 | ,063  ,476 | ,112  ,209 | ,066 | ,104  ,241 |
| ,169 | ,000 | ,374 | ,868 | ,923 | ,000 | ,872 | ,832 | ,174 |  | ,464 |
| N | 130 | 129 | 130 | 130 | 130 | 129 | 129 | 130 | 127 | 128 | 129 | 130 | 130 | 130 | 130 | 129 | 128 | 127 | 129 |
| In-depth education about blockchaintechnologie s for ITprofessional s and administrati ve-officers in the educational  -sector | | Pears on Corre  lation | ,159 | ,091 | ,130 | ,154  ,081  130 | ,031 | ,266\*\* | ,232\*\* | ,230\*\* | ,148 | ,170 | ,213\* | ,140 | ,052 | ,251\*\* | ,315\*\* | ,063 | 1 | ,255\*\* | ,213\* | ,254\*\* |
| Sig. (2tailed  ) | ,070 | ,306 | ,138 | ,724 | ,002 | ,008 | ,008 | ,091 | ,055 | ,016 | ,111 | ,555 | ,004 | ,000 | ,476 |  | ,003 | ,016 | ,004 |
| N | 131 | 130 | 131 | 131 | 131 | 130 | 130 | 131 | 128 | 129 | 130 | 131 | 131 | 129 | 129 | 131 | 129 | 128 | 130 |
| The  possibility to process information | | Pears on Corre  lation | ,109 | ,248\*\* | ,285\*\* | ,185\* | ,234\*\* | ,262\*\* | ,289\*\* | ,302\*\* | ,299\*\* | ,164 | ,262\*\* | ,179\* | ,114 | ,220\* | ,395\*\* | ,112 | ,255\*\* | 1 | ,262\*\* | ,162 |
|  | from various blockchainsystems | Sig. (2tailed  ) | ,219 | ,005 | ,001 | ,036  129 | ,007 | ,003 | ,001 | ,001 | ,001 | ,065 | ,003 | ,042 | ,197 | ,012 | ,000 | ,209 | ,003 |  | ,003 | ,066 |
|  | N | 130 | 129 | 130 | 130 | 130 | 129 | 129 | 130 | 127 | 128 | 129 | 130 | 130 | 128 | 128 | 129 | 130 | 127 | 129 |
|  | Clear and transparent rules about who is responsible for payment of fees | Pears on Corre  lation Sig. (2tailed  ) | ,156 | ,135 | ,193\*  ,029 | ,046  ,606  128 | ,060  ,496 | ,195\* | ,104 | ,122 | ,073 | ,065  ,471 | ,102  ,253 | ,065  ,467 | ,008 | ,125 | ,124 | ,066 | ,213\*  ,016 | ,262\*\*  ,003 | 1 | ,271\*\*  ,002 |
|  | ,078 | ,128 | ,027 | ,242 | ,169 | ,412 | ,932 | ,157 | ,164 | ,464 |  |
|  | N | 129 | 128 | 129 | 129 | 129 | 128 | 128 | 129 | 126 | 127 | 128 | 129 | 129 | 127 | 127 | 128 | 127 | 129 | 128 |
|  | Basic information /education about blockchaintechnologie  s for all people involved in the educational sector | Pears on Corre  lation | ,320\*\* | ,353\*\* | ,205\* | ,273\*\*  ,002  130 | ,225\*\* | ,378\*\* | ,143 | ,272\*\* | ,204\* | ,198\* | ,205\* | -,120 | ,075 | ,133 | ,172 | ,104 | ,254\*\* | ,162 | ,271\*\* | 1 |
|  | Sig. (2tailed  ) | ,000 | ,000 | ,019 | ,010 | ,000 | ,105 | ,002 | ,020 | ,025 | ,020 | ,173 | ,392 | ,129 | ,052 | ,241 | ,004 | ,066 | ,002 |  |
|  | N | 131 | 130 | 131 | 131 | 131 | 130 | 130 | 131 | 128 | 129 | 130 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 131 |

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,301), between the use of blockchain technologies for certificate management and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for certificate management may lead to an increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,285), between the use of blockchain technologies for certificate management and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for certificate management may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,320), between the use of blockchain technologies for certificate management and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for certificate management may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,025 and R = 0,196), between the use of blockchain technologies for competencies and learning outcomes management and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to a small increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,289), between the use of blockchain technologies for competencies and learning outcomes management and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,308), between the use of blockchain technologies for competencies and learning outcomes management and the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to an increase in the need to consider, ―involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,248), between the use of blockchain technologies for competencies and learning outcomes management and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,353), between the use of blockchain technologies for competencies and learning outcomes management and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for competencies and learning outcomes management may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,012 and R = 0,218), between the use of blockchain technologies for evaluating students’ prefessional ability and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ prefessional ability may lead to a small increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,285), between the use of blockchain technologies for evaluating students’ prefessional ability and the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ prefessional ability may lead to an increase in the need to consider, ―involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,001 and R = 0,285), between the use of blockchain technologies for evaluating students’ prefessional ability and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ prefessional ability may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,019 and R = 0,205), between the use of blockchain technologies for evaluating students’ prefessional ability and the need to consider "basic information/education about blockchaintechnologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for evaluating students’ prefessional ability may lead to a small increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,254), between the use of blockchain technologies for securing collaborative learning environment and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for securing collaborative learning environment may lead to an increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,352), between the use of blockchain technologies for securing collaborative learning environment and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for securing collaborative learning environment may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,036 and R = 0,185), between the use of blockchain technologies for securing collaborative learning environment and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for securing collaborative learning environment may lead to a small increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,273), between the use of blockchain technologies for securing collaborative learning environment and the need to consider "basic information/education about blockchaintechnologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for securing collaborative learning environment may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,018 and R = 0,205), between the use of blockchain technologies for protecting learning objects and the need to consider "everything has to be set up with open-source technologies" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for protecting learning objects may lead to a small increase in the need to consider, ―everything has to be set up with open-source technologies" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,276), between the use of blockchain technologies for protecting learning objects and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for protecting learning objects may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,007 and R = 0,234), between the use of blockchain technologies for protecting learning objects and the need to consider "the possibility to process information from various blockchainsystems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for protecting learning objects may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,010 and R = 0,225), between the use of blockchain technologies for protecting learning objects and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for protecting learning objects may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,246), between the use of blockchain technologies for fees and credits transfer and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to an increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,361), between the use of blockchain technologies for fees and credits transfer and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,266), between the use of blockchain technologies for fees and credits transfer and the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to an increase in the need to consider, ―in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,003 and R = 0,262), between the use of blockchain technologies for fees and credits transfer and the need to consider "the possibility to process information from various blockchainsystems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,027 and R = 0,195), between the use of blockchain technologies for fees and credits transfer and the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to a small increase in the need to consider, ―clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,378), between the use of blockchain technologies for fees and credits transfer and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for fees and credits transfer may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,017 and R = 0,208), between the use of blockchain technologies for obtaining digital guardianship consent and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent may lead to a small increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,286), between the use of blockchain technologies for obtaining digital guardianship consent and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,008 and R = 0,232), between the use of blockchain technologies for obtaining digital guardianship consent and the need to consider "in-depth education about blockchaintechnologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent may lead to an increase in the need to consider, ―in-depth education about blockchaintechnologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,289), between the use of blockchain technologies for obtaining digital guardianship consent and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for obtaining digital guardianship consent may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,381), between the use of blockchain technologies for copyrights management and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to an increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,008 and R = 0,230), between the use of blockchain technologies for copyrights management and the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to an increase in the need to consider, ―in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,302), between the use of blockchain technologies for copyrights management and the need to consider "the possibility to process information from various blockchainsystems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,272), between the use of blockchain technologies for copyrights management and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for copyrights management may lead to an increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,010 and R = 0,223), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need to consider "everything has to be set up with open-source technologies" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to a small increase in the need to consider, ―everything has to be set up with open-source technologies" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,023 and R = 0,199), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to a small increase in the need to consider, ―the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,000.. and R = 0,313), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to an increase in the need to consider, ―involving corporations in the process of setting up Blockchaintechnologies in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig

= 0,001 and R = 0,299), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,020 and R = 0,204), between the use of blockchain technologies for enhancing students’ interactions in e-learning and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for enhancing students’ interactions in e-learning may lead to a small increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,009 and R = 0,229), between the use of blockchain technologies for supporting lifelong learning and the need to consider "everything has to be set up with open-source technologies" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for supporting lifelong learning may lead to an increase in the need to consider, ―everything has to be set up with open-source technologies" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,345), between the use of blockchain technologies for supporting lifelong learning and the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for supporting lifelong learning may lead to an increase in the need to consider, ―involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,025 and R = 0,198), between the use of blockchain technologies for supporting lifelong learning and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for supporting lifelong learning may lead to a small increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,257), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "everything has to be set up with open-source technologies" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to an increase in the need to consider, ―everything has to be set up with open-source technologies" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,026 and R = 0,195), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need to consider, ―the ability to get a copy of data that can be stored on nodes, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,015 and R = 0,215), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need to consider, ―involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,016 and R = 0,213), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "in-depth education about blockchain-technologies for It professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need to consider, ―in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,262), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to an increase in the need to consider, ―the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,020 and R = 0,205), between the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain and the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector. From this correlation it can be seen that an increase in the use of blockchain technologies for allowing employers and other organizations to view to view student’ educational results and other qualifications on a blockchain may lead to a small increase in the need to consider, ―basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector.

*H3 - Knowledge of blockchain technologies in different professions influences the benefits of adopting blockchain technologies*

In order to be able to analyze H3, the 7 subpoints from question 6 (The level of knowledge about blockchain technologies of different professions) and the 9 subpoints from question 7 (The benefits of adopting blockchain technologies in education) will be taken into account. Table 4.73 shows the correlation between the variables of H3:

**Table 4.73: Correlations H3**

**Correlations**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Teacher  -  Knowle dge of  blockch ain-  technolo  giesin the  educatio nal sector | Adminis trative  IT-  Officer -  Knowle dge of  blockch ain-  technolo  giesin the  educatio nal sector | Adminis trative  Non-IT-  Officer -  Knowle dge of  blockch ain-  technolo  giesin the  educatio nal sector | Headmaster/Re ctor/Dean -  Knowledge of blockchain-  technologiesin  the educational sector | Educati onal App-  Develop er -  Knowle dge of  blockch ain-  technolo  giesin the  educatio nal sector | Researc her in  the field of  educatio n and  educatio nal  technolo gies -  Knowle dge of  blockch ain-  technolo  giesin the  educatio nal sector | Hardware/S oftware  Specialist -  Knowledge  of  blockchain-  technologie sin the  educational sector | Benefit of  blockc hain  technol ogies -  Enhan cing  learner  s'  activit y | Benefit of  blockc hain  technol ogies -  Suppor ting  learner  s'  career  decisio ns | Benefit of  blockc hain  technol ogies -  Improv ing  manag ement of  student  ’s records | Benefit of  blockc hain  technol ogies -  Enhan cing trust | Benefit of  blockch ain  technol ogies - Identity authenti cation | Benefit of  blockc hain  technol ogies -  Better control of data access | Benefit of  blockc hain  technol ogies -  Enhan cing  student s’  assess ment | Benefit of  blockc hain  technol ogies -  Low cost | Benefit of  blockc hain  technol ogies -  High securit y |
| Teacher - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | 1 | ,298\*\* | ,330\*\*  ,000  129 | ,317\*\* | ,091 | ,149 | ,002 | ,348\*\* | ,243\*\* | ,081 | ,101 | ,144  ,108  126 | ,182\* | ,169 | ,227\* | ,263\*\* |
| Sig. (2tailed) |  | ,001 | ,000 | ,307 | ,090 | ,980 | ,000 | ,005 | ,360 | ,258 | ,038 | ,055 | ,010 | ,003 |
| N | 130 | 130 | 129 | 129 | 130 | 129 | 130 | 130 | 130 | 128 | 130 | 130 | 128 | 129 |
| Administrative  IT-Officer - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,298\*\* | 1 | ,274\*\*  ,002  131 | ,237\*\* | ,203\* | ,120 | ,192\* | ,095 | ,038 | ,119 | ,004 | ,066  ,462  128 | ,169 | ,106 | ,134 | ,211\* |
| Sig. (2tailed) | ,001 |  | ,006 | ,020 | ,171 | ,028 | ,279 | ,667 | ,175 | ,963 | ,052 | ,227 | ,128 | ,016 |
| N | 130 | 132 | 131 | 131 | 132 | 131 | 132 | 132 | 132 | 130 | 132 | 132 | 130 | 131 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Administrative  Non-IT-Officer - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,330\*\* | ,274\*\* | 1    131 | ,526\*\* | ,105 | ,136 | ,044 | ,226\*\* | ,259\*\* | ,135 | ,031 | ,081  ,366  127 | ,063 | ,233\*\* | ,309\*\* | ,130 |
| Sig. (2tailed) | ,000 | ,002 | ,000 | ,233 | ,120 | ,621 | ,009 | ,003 | ,123 | ,729 | ,477 | ,007 | ,000 | ,139 |
| N | 129 | 131 | 130 | 130 | 131 | 130 | 131 | 131 | 131 | 129 | 131 | 131 | 129 | 130 |
| Headmaster/Re ctor/Dean -  Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,317\*\* | ,237\*\* | ,526\*\*  ,000  130 | 1 | ,242\*\* | ,242\*\* | ,106 | ,205\* | ,245\*\* | ,157 | ,004 | ,180\*  ,043  127 | ,202\* | ,238\*\* | ,224\* | ,123 |
| Sig. (2tailed) | ,000 | ,006 |  | ,005 | ,005 | ,229 | ,019 | ,005 | ,073 | ,963 | ,021 | ,006 | ,011 | ,163 |
| N | 129 | 131 | 131 | 130 | 131 | 130 | 131 | 131 | 131 | 129 | 131 | 131 | 129 | 130 |
| Educational  App-Developer - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,091 | ,203\* | ,105  ,233  130 | ,242\*\* | 1 | ,403\*\* | ,390\*\* | -,021 | ,014 | ,208\* | ,299\*\* | ,257\*\*  ,004  127 | ,277\*\* | ,105 | ,143 | ,140 |
| Sig. (2tailed) | ,307 | ,020 | ,005 |  | ,000 | ,000 | ,814 | ,875 | ,017 | ,001 | ,001 | ,232 | ,107 | ,112 |
| N | 129 | 131 | 130 | 131 | 131 | 130 | 131 | 131 | 131 | 129 | 131 | 131 | 129 | 130 |
| Researcher in the field of education and educational technologies - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,149 | ,120 | ,136  ,120  131 | ,242\*\* | ,403\*\* | 1 | ,370\*\* | ,111 | ,232\*\* | ,314\*\* | ,198\* | ,164  ,065  128 | ,195\* | ,126 | ,199\* | ,144 |
| Sig. (2tailed) | ,090 | ,171 | ,005 | ,000 |  | ,000 | ,205 | ,007 | ,000 | ,024 | ,025 | ,150 | ,023 | ,102 |
| N | 130 | 132 | 131 | 131 | 132 | 131 | 132 | 132 | 132 | 130 | 132 | 132 | 130 | 131 |
| Hardware/Soft ware Specialist - Knowledge of blockchaintechnologiesin the educational sector | Pearso n Correl ation | ,002 | ,192\* | ,044  ,621  130 | ,106 | ,390\*\* | ,370\*\* | 1 | -,013 | ,087 | ,105 | ,139 | ,042  ,642  128 | ,185\* | ,135 | ,055 | ,071 |
| Sig. (2tailed) | ,980 | ,028 | ,229 | ,000 | ,000 |  | ,882 | ,321 | ,231 | ,114 | ,033 | ,122 | ,531 | ,422 |
| N | 129 | 131 | 130 | 130 | 131 | 132 | 132 | 132 | 132 | 130 | 132 | 132 | 130 | 131 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Benefit of blockchain technologies - Enhancing  learners' activity | Pearso n Correl ation | ,348\*\* | ,095 | ,226\*\*  ,009  131 | ,205\* | -,021 | ,111 | -,013 | 1 | ,599\*\* | ,209\* | ,137 | ,022  ,801  129 | ,130 | ,490\*\* | ,262\*\* | ,102 |
| Sig. (2tailed) | ,000 | ,279 | ,019 | ,814 | ,205 | ,882 |  | ,000 | ,016 | ,118 | ,137 | ,000 | ,002 | ,244 |
| N | 130 | 132 | 131 | 131 | 132 | 132 | 133 | 133 | 133 | 131 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Supporting learners' career decisions | Pearso n Correl ation | ,243\*\* | ,038 | ,259\*\*  ,003  131 | ,245\*\* | ,014 | ,232\*\* | ,087 | ,599\*\* | 1 | ,127 | ,120 | ,068  ,442  129 | ,132 | ,466\*\* | ,270\*\* | ,091 |
| Sig. (2tailed) | ,005 | ,667 | ,005 | ,875 | ,007 | ,321 | ,000 |  | ,146 | ,171 | ,129 | ,000 | ,002 | ,298 |
| N | 130 | 132 | 131 | 131 | 132 | 132 | 133 | 133 | 133 | 131 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Improving management of student’s records | Pearso n Correl ation | ,081 | ,119 | ,135  ,123  131 | ,157 | ,208\* | ,314\*\* | ,105 | ,209\* | ,127 | 1 | ,444\*\* | ,309\*\*  ,000  129 | ,394\*\* | ,273\*\* | ,257\*\* | ,283\*\* |
| Sig. (2tailed) | ,360 | ,175 | ,073 | ,017 | ,000 | ,231 | ,016 | ,146 |  | ,000 | ,000 | ,001 | ,003 | ,001 |
| N | 130 | 132 | 131 | 131 | 132 | 132 | 133 | 133 | 133 | 131 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Enhancing  trust | Pearso n Correl ation | ,101 | ,004 | ,031  ,729  129 | ,004 | ,299\*\* | ,198\* | ,139 | ,137 | ,120 | ,444\*\* | 1 | ,492\*\*  ,000  128 | ,335\*\* | ,206\* | ,189\* | ,364\*\* |
| Sig. (2tailed) | ,258 | ,963 | ,963 | ,001 | ,024 | ,114 | ,118 | ,171 | ,000 |  | ,000 | ,018 | ,032 | ,000 |
| N | 128 | 130 | 129 | 129 | 130 | 130 | 131 | 131 | 131 | 131 | 131 | 131 | 129 | 130 |
| Benefit of blockchain technologies - Identity authentication | Pearso n Correl ation | ,144 | ,066 | ,081  ,366  127 | ,180\* | ,257\*\* | ,164 | ,042 | ,022 | ,068 | ,309\*\* | ,492\*\* | 1    129 | ,542\*\* | ,255\*\* | ,241\*\* | ,454\*\* |
| Sig. (2tailed) | ,108 | ,462 | ,043 | ,004 | ,065 | ,642 | ,801 | ,442 | ,000 | ,000 | ,000 | ,004 | ,006 | ,000 |
| N | 126 | 128 | 127 | 127 | 128 | 128 | 129 | 129 | 129 | 128 | 129 | 129 | 127 | 128 |
| Benefit of blockchain technologies - Better control of data access | Pearso n Correl ation | ,182\* | ,169 | ,063  ,477  131 | ,202\* | ,277\*\* | ,195\* | ,185\* | ,130 | ,132 | ,394\*\* | ,335\*\* | ,542\*\*  ,000  129 | 1 | ,410\*\* | ,219\* | ,348\*\* |
| Sig. (2tailed) | ,038 | ,052 | ,021 | ,001 | ,025 | ,033 | ,137 | ,129 | ,000 | ,000 |  | ,000 | ,012 | ,000 |
| N | 130 | 132 | 131 | 131 | 132 | 132 | 133 | 133 | 133 | 131 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Enhancing students’ assessment | Pearso n Correl ation | ,169 | ,106 | ,233\*\*  ,007  131 | ,238\*\* | ,105 | ,126 | ,135 | ,490\*\* | ,466\*\* | ,273\*\* | ,206\* | ,255\*\*  ,004  129 | ,410\*\* | 1 | ,388\*\* | ,235\*\* |
| Sig. (2tailed) | ,055 | ,227 | ,006 | ,232 | ,150 | ,122 | ,000 | ,000 | ,001 | ,018 | ,000 |  | ,000 | ,007 |
| N | 130 | 132 | 131 | 131 | 132 | 132 | 133 | 133 | 133 | 131 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Low cost | Pearso n Correl ation | ,227\* | ,134 | ,309\*\*  ,000  129 | ,224\* | ,143 | ,199\* | ,055 | ,262\*\* | ,270\*\* | ,257\*\* | ,189\* | ,241\*\*  ,006  127 | ,219\* | ,388\*\* | 1 | ,282\*\* |
| Sig. (2tailed) | ,010 | ,128 | ,011 | ,107 | ,023 | ,531 | ,002 | ,002 | ,003 | ,032 | ,012 | ,000 |  | ,001 |
| N | 128 | 130 | 129 | 129 | 130 | 130 | 131 | 131 | 131 | 129 | 131 | 131 | 131 | 131 |
| Benefit of blockchain technologies - High security | Pearso n Correl ation | ,263\*\* | ,211\* | ,130  ,139  130 | ,123 | ,140 | ,144 | ,071 | ,102 | ,091 | ,283\*\* | ,364\*\* | ,454\*\*  ,000  128 | ,348\*\* | ,235\*\* | ,282\*\* | 1 |
| Sig. (2tailed) | ,003 | ,016 | ,163 | ,112 | ,102 | ,422 | ,244 | ,298 | ,001 | ,000 | ,000 | ,007 | ,001 |  |
| N | 129 | 131 | 130 | 130 | 131 | 131 | 132 | 132 | 132 | 130 | 132 | 132 | 131 | 132 |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

\*. Correlation is significant at the 0.05 level (2-tailed).

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,348), between the need for high knowledge of the teacher and the enhancing learners' activity. From this correlation it can be seen that an increase in the need for high knowledge of the teacher can lead to an increase in the enhancing learners' activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,243), between the need for high knowledge of the teacher and the supporting learners' career decisions. From this correlation it can be seen that an increase in the need for high knowledge of the teacher can lead to an increase in the supporting learners' career decisions.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,038 and R = 0,182), between the need for high knowledge of the teacher and the better control of data access. From this correlation it can be seen that an increase in the need for high knowledge of the teacher can lead to a small increase in the better control of data access.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,010 and R = 0,227), between the need for high knowledge of the teacher and low cost. From this correlation it can be seen that an increase in the need for high knowledge of the teacher can lead to a small increase in the low cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,263), between the need for high knowledge of the teacher and the high security. From this correlation it can be seen that an increase in the need for high knowledge of the teacher can lead to an increase in the high security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,016 and R = 0,211), between the need for high knowledge of the administrative IT-officer and high security. From this correlation it can be seen that an increase in the need for high knowledge of the administrative IT-officer can lead to a small increase in the high security.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,009 and R = 0,226), between the need for high knowledge of the administrative non-ITofficer and the enhancing learners' activity. From this correlation it can be seen that an increase in the need for high knowledge of the administrative non-IT-officer can lead to an increase in the enhancing learners' activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,259), between the need for high knowledge of the administrative non-ITofficer and the supporting learners' career decisions. From this correlation it can be seen that an increase in the need for high knowledge of the administrative non-IT-officer can lead to an increase in the supporting learners' career decisions.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,007 and R = 0,233), between the need for high knowledge of the administrative non-ITofficer and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need for high knowledge of the administrative non-IT-officer can lead to an increase in the enhancing students’ assessment.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,309), between the need for high knowledge of the administrative non-ITofficer and the low cost. From this correlation it can be seen that an increase in the need for high knowledge of the administrative non-IT-officer can lead to an increase in the low cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,019 and R = 0,205), between the need for high knowledge of the headmaster/rector/decan and enhancing learners' activity. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to a small increase in the enhancing learners' activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,245), between the need for high knowledge of the headmaster/rector/decan and the supporting learners' career decisions. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to an increase in the supporting learners' career decisions.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,043 and R = 0,180), between the need for high knowledge of the headmaster/rector/decan and identity authentication. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to a small increase in the identity authentication.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,021 and R = 0,202), between the need for high knowledge of the headmaster/rector/decan and better control of data access. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to a small increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,006 and R = 0,238), between the need for high knowledge of the headmaster/rector/decan and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to an increase in the enhancing students’ assessment.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig =

0,011 and R = 0,224), between the need for high knowledge of the headmaster/rector/decan and low cost. From this correlation it can be seen that an increase in the need for high knowledge of the headmaster/rector/decan can lead to a small increase in the low cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,017 and R = 0,208), between the need for high knowledge of the educational app-developer and improving management of student’s records. From this correlation it can be seen that an increase in the need for high knowledge of the educational app-developer can lead to a small increase in the improving management of student’s records.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,299), between the need for high knowledge of the educational app-developer and the enhancing trust. From this correlation it can be seen that an increase in the need for high knowledge of the educational app-developer can lead to an increase in the enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,004 and R = 0,257), between the need for high knowledge of the educational app-developer and the identity authentication. From this correlation it can be seen that an increase in the need for high knowledge of the educational app-developer can lead to an increase in the identity authentication.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,277), between the need for high knowledge of the educational app-developer and the better control of data access. From this correlation it can be seen that an increase in the need for high knowledge of the educational app-developer can lead to an increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,007 and R = 0,232), between the need for high knowledge of the researcher in the field of education and educational technologies and the supporting learners' career decisions. From this correlation it can be seen that an increase in the need for high knowledge of the researcher in the field of education and educational technologies can lead to an increase in the supporting learners' career decisions.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,314), between the need for high knowledge of the researcher in the field of education and educational technologies and the improving management of student’s records. From this correlation it can be seen that an increase in the need for high knowledge of the researcher in the field of education and educational technologies can lead to an increase in the improving management of student’s records.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,024 and R = 0,198), between the need for high knowledge of the researcher in the field of education and educational technologies and enhancing trust. From this correlation it can be seen that an increase in the need for high knowledge of the researcher in the field of education and educational technologies can lead to a small increase in the enhancing trust.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,025 and R = 0,195), between the need for high knowledge of the researcher in the field of education and educational technologies and better control of data access. From this correlation it can be seen that an increase in the need for high knowledge of the researcher in the field of education and educational technologies can lead to a small increase in the better control of data access.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,023 and R = 0,199), between the need for high knowledge of the researcher in the field of education and educational technologies and low cost. From this correlation it can be seen that an increase in the need for high knowledge of the researcher in the field of education and educational technologies can lead to a small increase in the low cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,033 and R = 0,185), between the need for high knowledge of the hardware/software specialist and educational technologies and better control of data access. From this correlation it can be seen that an increase in the need for high knowledge of the hardware/software specialist can lead to a small increase in the better control of data access.

*H4 - Issues to consider before including blockchain technologies in the education sector influence the benefits of adopting blockchain technologies*

In order to be able to analyze H4, the 9 subpoints from question 4 (Issues to consider before including blockchain technologies in the education sector) and the 9 subpoints from question 7 (The benefits of adopting blockchain technologies in education) will be taken into account. Table 4.74 shows the correlation between the variables of H4:

**Table 4.74: Correlations H4**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Involve ment of  Govern ment, strict  worldw ide  regulati on | Everyt hing  has to  be set up  with open-  source  technol ogies | The abilit y to  get a copy  of my own data that can be  stored on  my  own  node, regar dless of  which block chain  syste m  was  origin ally used | The abilit y to  operat e a  full  node and  store an  encry pted  copy  of the block chain used to  store  crede  ntials | Involvi ng  corpor ations in the  proces s of  setting up  Blockc hain-  technol ogies  in the  educati onal sector | In-depth educatio n about  blockch ain-  technolo  gies for  ITprofessi onals and  administ rative-  officers in the  educatio nalsector | The possib  ility to proces s  inform ation from  variou s  blockc hainsyste ms | Clear and  transp arent rules  about who is  respo  nsible for  paym  ent of fees | Basic information/  education about  blockchain-  technologies  for all people  involved in the  educational sector | Benefit of  blockc hain  technol ogies -  Enhan cing  learner  s'  activit y | Benefit of  blockc hain  technol ogies -  Suppor ting  learner  s'  career decisio ns | Benefit of  blockc hain  technol ogies -  Improv ing  manag ement of  student  ’s records | Benefit of  blockc hain  technol ogies -  Enhan cing trust | Benefit of  blockch ain  technol ogies - Identity authenti cation | Benefit of  blockc hain  technol ogies -  Better control of data access | Benefit of  blockc hain  technol ogies -  Enhan cing  student s’  assess ment | Benefit of  blockc hain  technol ogies -  Low cost | Benefit of  blockc hain  technol ogies -  High securit y |
| Involvement of  Government,  strict  worldwide regulation | Pears on Correl ation | 1 | -,061 | ,085 | ,083 | ,170 | ,140 | ,179\* | ,065 | -,120 | ,188\* | ,053 | ,034 | ,017 | ,120 | ,039 | ,155 | ,252\*\* | ,215\* |
| Sig. (2tailed) |  | ,490 | ,334 | ,349 | ,054 | ,111 | ,042 | ,467 | ,173 | ,032 | ,548 | ,697 | ,850 | ,178 | ,660 | ,078 | ,004 | ,013 |
| N | 131 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 130 | 131 | 131 | 131 | 129 | 127 | 131 | 131 | 130 | 131 |
| Everything has to be set up with open-source | Pears on Correl ation | -,061 | 1 | ,253\*\* | ,233\*\* | ,014 | ,052 | ,114 | ,008 | ,075 | ,374\*\* | ,270\*\* | ,131 | ,208\* | ,127 | ,142 | ,253\*\* | ,156 | -,004 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| technologies Sig. (2tailed) | | ,490 |  | ,003 | ,008 | ,872 | ,555 | ,197 | ,932 | ,392 | ,000 | ,002 | ,135 | ,017 | ,152 | ,105 | ,003 | ,075 | ,962 |
| N | | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 132 | 132 | 132 | 130 | 128 | 132 | 132 | 131 | 132 |
| The ability to Pears get a copy of on my own data Correl that can be ation | | ,085 | ,253\*\* | 1 | ,422\*\* | ,019 | ,251\*\* | ,220\* | ,125 | ,133 | ,217\* | ,034 | ,341\*\* | ,368\*\* | ,346\*\* | ,266\*\* | ,127 | ,313\*\* | ,197\* |
| stored on my Sig. own node, (2-  regardless of tailed) | | ,334 | ,003 |  | ,000 | ,832 | ,004 | ,012 | ,157 | ,129 | ,013 | ,699 | ,000 | ,000 | ,000 | ,002 | ,146 | ,000 | ,024 |
| which N  blockchain system was originally used | | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 132 | 132 | 132 | 130 | 128 | 132 | 132 | 131 | 132 |
| The ability to operate a full node and store an encrypted copy of the blockchain used to store credentials | Pears on Correl ation | ,083 | ,233\*\* | ,422\*\* | 1 | ,120 | ,315\*\* | ,395\*\* | ,124 | ,172 | ,210\* | ,172 | ,133 | ,234\*\* | ,396\*\* | ,295\*\* | ,237\*\* | ,271\*\* | ,413\*\* |
| Sig. (2tailed)  N | ,349 | ,008 | ,000  130 |  | ,174  130 | ,000 | ,000 | ,164  127 | ,052 | ,016 | ,051 | ,131  130 | ,008 | ,000 | ,001  130 | ,007 | ,002  129 | ,000 |
| 129 | 130 | 130 | 129 | 128 | 129 | 130 | 130 | 128 | 126 | 130 | 130 |
| Involving corporations in the process of setting up Blockchaintechnologies in the educational sector | Pears on Correl ation | ,170 | ,014 | ,019 | ,120 | 1 | ,063 | ,112 | ,066 | ,104 | ,316\*\* | ,372\*\* | ,139 | ,107 | ,051 | ,035 | ,285\*\* | ,178\* | -,007 |
| Sig. (2tailed)  N | ,054 | ,872 | ,832  130 | ,174 | 130 | ,476 | ,209 | ,464  127 | ,241 | ,000 | ,000 | ,114  130 | ,230 | ,570 | ,695  130 | ,001 | ,043  129 | ,935 |
| 129 | 130 | 130 | 129 | 128 | 129 | 130 | 130 | 128 | 126 | 130 | 130 |
| In-depth education about blockchaintechnologies for ITprofessionals | Pears on Correl ation | ,140 | ,052 | ,251\*\* | ,315\*\* | ,063 | 1 | ,255\*\* | ,213\* | ,254\*\* | ,123 | ,107 | ,225\*\* | ,170 | ,290\*\* | ,278\*\* | ,227\*\* | ,123 | ,253\*\* |
| Sig. (2tailed) | ,111 | ,555 | ,004 | ,000 | ,476 |  | ,003 | ,016 | ,004 | ,161 | ,223 | ,010 | ,054 | ,001 | ,001 | ,009 | ,160 | ,004 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| and administrativ e-officers in the educationalsector | N | 130 | 131 | 131 | 129 | 129 | 131 | 129 | 128 | 130 | 131 | 131 | 131 | 129 | 127 | 131 | 131 | 131 | 131 |
| The  possibility to process information from various blockchainsystems | Pears on Correl ation | ,179\* | ,114 | ,220\* | ,395\*\* | ,112 | ,255\*\* | 1 | ,262\*\* | ,162 | ,191\* | ,193\* | ,212\* | ,138 | ,230\*\* | ,278\*\* | ,208\* | ,385\*\* | ,292\*\* |
| Sig. (2tailed) | ,042 | ,197 | ,012 | ,000 | ,209 | ,003 |  | ,003 | ,066 | ,029 | ,027 | ,015 | ,120 | ,010 | ,001 | ,018 | ,000 | ,001 |
| N | 129 | 130 | 130 | 128 | 128 | 129 | 130 | 127 | 129 | 130 | 130 | 130 | 128 | 126 | 130 | 130 | 129 | 130 |
| Clear and transparent rules about who is responsible for payment of fees | Pears on Correl ation | ,065 | ,008 | ,125 | ,124 | ,066 | ,213\* | ,262\*\* | 1 | ,271\*\* | ,125 | -,012 | ,191\* | ,228\* | ,030 | ,017 | ,032 | ,243\*\* | ,235\*\* |
| Sig. (2tailed) | ,467 | ,932 | ,157 | ,164 | ,464 | ,016 | ,003 |  | ,002 | ,159 | ,893 | ,030 | ,010 | ,738 | ,847 | ,717 | ,006 | ,007 |
| N | 128 | 129 | 129 | 127 | 127 | 128 | 127 | 129 | 128 | 129 | 129 | 129 | 127 | 125 | 129 | 129 | 128 | 129 |
| Basic information/ education about blockchaintechnologies for all people involved in the educational sector | Pears on Correl ation Sig. (2tailed) | -,120 | ,075 | ,133  ,129 | ,172 | ,104  ,241 | ,254\*\* | ,162 | ,271\*\*  ,002 | 1 | ,103 | ,202\* | ,275\*\*  ,001 | ,176\* | ,128 | ,301\*\*  ,000 | ,311\*\* | ,011  ,899 | ,245\*\* |
| ,173 | ,392 | ,052 | ,004 | ,066 |  | ,244 | ,021 | ,046 | ,152 | ,000 | ,005 |
| N | 130 | 131 | 131 | 129 | 129 | 130 | 129 | 128 | 131 | 131 | 131 | 131 | 129 | 127 | 131 | 131 | 130 | 131 |
| Benefit of blockchain technologies - Enhancing learners' activity | Pears on Correl ation Sig. (2tailed) | ,188\* | ,374\*\* | ,217\*  ,013 | ,210\* | ,316\*\*  ,000 | ,123 | ,191\* | ,125  ,159 | ,103 | 1 | ,599\*\* | ,209\*  ,016 | ,137 | ,022 | ,130  ,137 | ,490\*\* | ,262\*\*  ,002 | ,102 |
| ,032 | ,000 | ,016 | ,161 | ,029 | ,244 |  | ,000 | ,118 | ,801 | ,000 | ,244 |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 133 | 133 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Benefit of blockchain technologies - Supporting learners' career decisions | Pears on Correl ation | ,053 | ,270\*\* | ,034 | ,172 | ,372\*\* | ,107 | ,193\* | -,012 | ,202\* | ,599\*\* | 1 | ,127 | ,120 | ,068 | ,132 | ,466\*\* | ,270\*\* | ,091 |
| Sig. (2tailed) | ,548 | ,002 | ,699 | ,051 | ,000 | ,223 | ,027 | ,893 | ,021 | ,000 |  | ,146 | ,171 | ,442 | ,129 | ,000 | ,002 | ,298 |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 133 | 133 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Improving management of student’s records | Pears on Correl ation | ,034 | ,131 | ,341\*\* | ,133 | ,139 | ,225\*\* | ,212\* | ,191\* | ,275\*\* | ,209\* | ,127 | 1 | ,444\*\* | ,309\*\* | ,394\*\* | ,273\*\* | ,257\*\* | ,283\*\* |
| Sig. (2tailed) | ,697 | ,135 | ,000 | ,131 | ,114 | ,010 | ,015 | ,030 | ,001 | ,016 | ,146 |  | ,000 | ,000 | ,000 | ,001 | ,003 | ,001 |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 133 | 133 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Enhancing trust | Pears on Correl ation | ,017 | ,208\* | ,368\*\* | ,234\*\* | ,107 | ,170 | ,138 | ,228\* | ,176\* | ,137 | ,120 | ,444\*\* | 1 | ,492\*\* | ,335\*\* | ,206\* | ,189\* | ,364\*\* |
| Sig. (2tailed) | ,850 | ,017 | ,000 | ,008 | ,230 | ,054 | ,120 | ,010 | ,046 | ,118 | ,171 | ,000 |  | ,000 | ,000 | ,018 | ,032 | ,000 |
| N | 129 | 130 | 130 | 128 | 128 | 129 | 128 | 127 | 129 | 131 | 131 | 131 | 131 | 128 | 131 | 131 | 129 | 130 |
| Benefit of blockchain technologies - Identity authenticatio  n | Pears on Correl ation | ,120 | ,127 | ,346\*\* | ,396\*\* | ,051 | ,290\*\* | ,230\*\* | ,030 | ,128 | ,022 | ,068 | ,309\*\* | ,492\*\* | 1 | ,542\*\* | ,255\*\* | ,241\*\* | ,454\*\* |
| Sig. (2tailed) | ,178 | ,152 | ,000 | ,000 | ,570 | ,001 | ,010 | ,738 | ,152 | ,801 | ,442 | ,000 | ,000 |  | ,000 | ,004 | ,006 | ,000 |
| N | 127 | 128 | 128 | 126 | 126 | 127 | 126 | 125 | 127 | 129 | 129 | 129 | 128 | 129 | 129 | 129 | 127 | 128 |
| Benefit of blockchain technologies - Better control of data access | Pears on Correl ation | ,039 | ,142 | ,266\*\* | ,295\*\* | ,035 | ,278\*\* | ,278\*\* | ,017 | ,301\*\* | ,130 | ,132 | ,394\*\* | ,335\*\* | ,542\*\* | 1 | ,410\*\* | ,219\* | ,348\*\* |
| Sig. (2tailed) | ,660 | ,105 | ,002 | ,001 | ,695 | ,001 | ,001 | ,847 | ,000 | ,137 | ,129 | ,000 | ,000 | ,000 |  | ,000 | ,012 | ,000 |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 133 | 133 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Enhancing students’ assessment | Pears on Correl ation | ,155 | ,253\*\* | ,127 | ,237\*\* | ,285\*\* | ,227\*\* | ,208\* | ,032 | ,311\*\* | ,490\*\* | ,466\*\* | ,273\*\* | ,206\* | ,255\*\* | ,410\*\* | 1 | ,388\*\* | ,235\*\* |
| Sig. (2tailed) | ,078 | ,003 | ,146 | ,007 | ,001 | ,009 | ,018 | ,717 | ,000 | ,000 | ,000 | ,001 | ,018 | ,004 | ,000 |  | ,000 | ,007 |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 133 | 133 | 133 | 131 | 129 | 133 | 133 | 131 | 132 |
| Benefit of blockchain technologies - Low cost | Pears on Correl ation | ,252\*\* | ,156 | ,313\*\* | ,271\*\* | ,178\* | ,123 | ,385\*\* | ,243\*\* | ,011 | ,262\*\* | ,270\*\* | ,257\*\* | ,189\* | ,241\*\* | ,219\* | ,388\*\* | 1 | ,282\*\* |
| Sig. (2tailed) | ,004 | ,075 | ,000 | ,002 | ,043 | ,160 | ,000 | ,006 | ,899 | ,002 | ,002 | ,003 | ,032 | ,006 | ,012 | ,000 |  | ,001 |
| N | 130 | 131 | 131 | 129 | 129 | 131 | 129 | 128 | 130 | 131 | 131 | 131 | 129 | 127 | 131 | 131 | 131 | 131 |
| Benefit of blockchain technologies - High security | Pears on Correl ation | ,215\* | -,004 | ,197\* | ,413\*\* | -,007 | ,253\*\* | ,292\*\* | ,235\*\* | ,245\*\* | ,102 | ,091 | ,283\*\* | ,364\*\* | ,454\*\* | ,348\*\* | ,235\*\* | ,282\*\* | 1 |
| Sig. (2tailed) | ,013 | ,962 | ,024 | ,000 | ,935 | ,004 | ,001 | ,007 | ,005 | ,244 | ,298 | ,001 | ,000 | ,000 | ,000 | ,007 | ,001 |  |
| N | 131 | 132 | 132 | 130 | 130 | 131 | 130 | 129 | 131 | 132 | 132 | 132 | 130 | 128 | 132 | 132 | 131 | 132 |

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,032 and R = 0,188), between the need to consider "involvement of Government, strict worldwide regulation" before including blockchain technologies in the education sector and enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "involvement of Government, strict worldwide regulation" may lead to a small increase in enhancing learners’ activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,004 and R = 0,252), between the need to consider "involvement of Government, strict worldwide regulation" before including blockchain technologies in the education sector and the low cost. From this correlation it can be seen that an increase in the need to consider "involvement of Government, strict worldwide regulation " may lead to an increase in the low cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,013 and R = 0,215), between the need to consider "involvement of Government, strict worldwide regulation" before including blockchain technologies in the education sector and high security. From this correlation it can be seen that an increase in the need to consider "involvement of Government, strict worldwide regulation" may lead to a small increase in high security.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,374), between the need to consider "everything has to be set up with opensource technologies" before including blockchain technologies in the education sector and the enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "everything has to be set up with open-source technologies" may lead to an increase in the enhancing learners’ activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,270), between the need to consider "everything has to be set up with opensource technologies" before including blockchain technologies in the education sector and the supporting learners' career decisions. From this correlation it can be seen that an increase in the need to consider "everything has to be set up with open-source technologies" may lead to an increase in the supporting learners' career decisions.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,017 and R = 0,208), between the need to consider "everything has to be set up with opensource technologies" before including blockchain technologies in the education sector and enhancing trust. From this correlation it can be seen that an increase in the need to consider "everything has to be set up with open-source technologies" may lead to a small increase in enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,003 and R = 0,253), between the need to consider "everything has to be set up with opensource technologies" before including blockchain technologies in the education sector and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "everything has to be set up with open-source technologies" may lead to an increase in the enhancing students’ assessment.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,013 and R = 0,217), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to a small increase in enhancing learners’ activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,341), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and the improving management of student’s records. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to an increase in the improving management of student’s records.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,368), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and the enhancing trust. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to an increase in the enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,346), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and the identity authentication. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to an increase in the identity authentication.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,266), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and the better control of data access. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to an increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,313), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and the low cost. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to an increase in the low cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,024 and R = 0,197), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and high security. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to a small increase in high security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,016 and R = 0,210), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to a small increase in enhancing learners’ activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,008 and R = 0,234), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the enhancing trust. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,396), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the identity authentication. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the identity authentication.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,295), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the better control of data access. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,007 and R = 0,237), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the enhancing students’ assessment.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,002 and R = 0,271), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the low cost. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the low cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,413), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and the high security. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the high security.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,316), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and the enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" may lead to an increase in the enhancing learners’ activity.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,372), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and the supporting learners’ career decisions. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" may lead to an increase in the supporting learners’ career decisions.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,285), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" may lead to an increase in the enhancing students’ assessment.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,043 and R = 0,178), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and low cost. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up Blockchain technologies in the educational sector" may lead to a small increase in low cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,010 and R = 0,225), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and the improving management of student’s records. From this correlation it can be seen that an increase in the need to consider "in depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" may lead to an increase in the improving management of student’s records.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,290), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and the identity authentication. From this correlation it can be seen that an increase in the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational sector" may lead to an increase in the identity authentication.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,278), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and the better control of data access.

From this correlation it can be seen that an increase in the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" may lead to an increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,009 and R = 0,227), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and the enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational-sector" may lead to an increase in the enhancing students’ assessment.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,004 and R = 0,253), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and the high security. From this correlation it can be seen that an increase in the need to consider "in-depth education about blockchain-technologies for IT-professionals and administrative-officers in the educational sector" may lead to an increase in the high security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,029 and R = 0,191), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and enhancing learners’ activity. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to a small increase in enhancing learners’ activity.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,027 and R = 0,193), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and supporting learners’ career decisions. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to a small increase in supporting learners’ career decisions.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,015 and R = 0,212), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and improving management of student’s records. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain systems" may lead to a small increase in improving management of student’s records.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,010 and R = 0,230), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and the identity authentication. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to an increase in the identity authentication.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,278), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and the better control of data access. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to an increase in the better control of data access.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,018 and R = 0,208), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to a small increase in enhancing students’ assessment.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,385), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and the low cost. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to an increase in the low cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,292), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and the high security. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to an increase in the high security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,030 and R = 0,191), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and improving management of student’s records. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to a small increase in improving management of student’s records.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,010 and R = 0,228), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and enhancing trust. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to a small increase in enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,006 and R = 0,243), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and the low cost. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to an increase in the low cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,007 and R = 0,235), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and the high security. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to an increase in the high security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,021 and R = 0,202), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and supporting learners’ career decisions. From this correlation it can be seen that an increase in the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" may lead to a small increase in supporting learners’ career decisions.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,275), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and the improving management of student’s records. From this correlation it can be seen that an increase in the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" may lead to an increase in the improving management of student’s records.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,046 and R = 0,176), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and enhancing trust. From this correlation an increase in the need to consider "basic information/education about blockchain technologies for all people involved in the educational sector" may lead to a small increase in enhancing trust.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,301), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and better control of data access. From this correlation it can be seen that an increase in the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" may lead to an increase in the better control of data access.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,000.. and R = 0,311), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and enhancing students’ assessment. From this correlation it can be seen that an increase in the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" may lead to an increase in the enhancing students’ assessment.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,245), between the need to consider "basic information/education about blockchain-technologies for all people involved in the educational sector" before including blockchain technologies in the education sector and high security. From this correlation it can be seen that an increase in the need to consider "basic information/education about blockchain technologies for all people involved in the educational sector" may lead to an increase in the high security.

*H5 - Issues to consider before including blockchain technologies in the education sector influence the challenges of adopting blockchain technologies*

In order to be able to analyze H5, the 9 subpoints from question 4 (Issues to consider before including blockchain technologies in the education sector) and the 9 subpoints from question 8

(Challenges of adopting blockchain technologies in education) will be taken into account. Table 4.75 shows the correlation between the variables of H5:

**Table 4.75: Correlations H5**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Involve ment of  Govern ment, strict  worldw ide  regulati on | Everyt hing  has to  be set up  with open-  source  technol ogies | The abilit y to  get a copy  of my own data that can be  stored on  my  own  node, regar dless of  which block chain  syste m  was  origin ally used | The abilit y to  operat e a  full  node and  store an  encry pted  copy  of the block chain used to  store  crede  ntials | Involvi ng  corpor ations in the  proces s of  setting up  Blockc hain-  technol ogies  in the  educati onal sector | In-depth educatio n about  blockch ain-  technolo  gies for  ITprofessi onals and  administ rative-  officers in the  educatio nalsector | The possib  ility to proces s  inform ation from  variou s  blockc hainsyste ms | Clear and  transp arent rules  about who is  respo  nsible for  paym  ent of fees | Basic information/  education about  blockchain-  technologies  for all people  involved in the  educational sector | Challe nges of blockc hain  technol ogies -  Weake ning  traditio nal  school  credent ials | Challe nges of blockc hain  technol ogies -  Trust | Challe nges of blockc hain  technol ogies -  Privac y &  Securit y | Challe nges of blockc hain  technol ogies -  Cost | Challe nges of blockc hain  technol ogies -  Immut  ability | Challe nges of blockc hain  technol ogies -  Scalabi lity | Challen ges of  blockch ain  technol ogies -  Data unavail ability | Challe nges of blockc hain  technol ogies -  Setting the  bounda ries | Challe nges of blockc hain  technol ogies -  Immat urity |
| Involvement of  Government,  strict  worldwide regulation | Pears on Correl ation | 1 | -,061 | ,085 | ,083  ,349  129 | ,170 | ,140 | ,179\* | ,065 | -,120 | ,220\* | ,089 | ,172 | ,063 | ,111 | ,155 | ,159 | ,072 | ,087 |
| Sig. (2tailed) |  | ,490 | ,334 | ,054 | ,111 | ,042 | ,467 | ,173 | ,013 | ,313 | ,052 | ,482 | ,217 | ,082 | ,072 | ,420 | ,326 |
| N | 131 | 131 | 131 | 129 | 130 | 129 | 128 | 130 | 128 | 129 | 128 | 128 | 125 | 127 | 129 | 128 | 129 |
| Everything has to be set up with open-source | Pears on Correl ation | -,061 | 1 | ,253\*\* | ,233\*\* | ,014 | ,052 | ,114 | ,008 | ,075 | -,071 | ,107 | ,117 | ,104 | ,002 | ,087 | -,071 | ,017 | -,030 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| technologies Sig. (2tailed) | | ,490 |  | ,003 | ,008  130 | ,872 | ,555 | ,197 | ,932 | ,392 | ,423 | ,225 | ,186 | ,240 | ,980 | ,329 | ,421 | ,847 | ,732 |
| N | | 131 | 132 | 132 | 130 | 131 | 130 | 129 | 131 | 129 | 130 | 129 | 129 | 126 | 128 | 130 | 129 | 130 |
| The ability to Pears get a copy of on my own data Correl that can be ation | | ,085 | ,253\*\* | 1 | ,422\*\*  ,000  130 | ,019 | ,251\*\* | ,220\* | ,125 | ,133 | -,073 | ,102 | ,073 | ,178\* | ,194\* | ,101 | ,120 | ,091 | ,068 |
| stored on my Sig. own node, (2-  regardless of tailed) | | ,334 | ,003 |  | ,832 | ,004 | ,012 | ,157 | ,129 | ,411 | ,247 | ,412 | ,044 | ,030 | ,258 | ,173 | ,304 | ,443 |
| which N  blockchain system was originally used | | 131 | 132 | 132 | 130 | 131 | 130 | 129 | 131 | 129 | 130 | 129 | 129 | 126 | 128 | 130 | 129 | 130 |
| The ability to operate a full node and store an encrypted copy of the blockchain used to store credentials | Pears on Correl ation | ,083 | ,233\*\* | ,422\*\* | 1    130 | ,120 | ,315\*\* | ,395\*\* | ,124 | ,172 | ,053 | ,057 | ,063 | ,057 | ,235\*\* | ,037 | ,161 | ,044 | ,006 |
| Sig. (2tailed)  N | ,349  129 | ,008  130 | ,000 | ,174 | ,000  129 | ,000 | ,164  127 | ,052 | ,551 | ,526 | ,483 | ,526 | ,008 | ,683 | ,069  128 | ,626  127 | ,946 |
| 130 | 130 | 128 | 129 | 127 | 128 | 127 | 127 | 124 | 126 | 128 |
| Involving corporations in the process of setting up Blockchaintechnologies in the educational sector | Pears on Correl ation | ,170 | ,014 | ,019 | ,120  ,174  130 | 1 | ,063 | ,112 | ,066 | ,104 | ,112 | -,119 | ,178\* | ,219\* | -,068 | -,019 | ,062 | -,063 | ,004 |
| Sig. (2tailed)  N | ,054  129 | ,872  130 | ,832 |  | ,476  129 | ,209 | ,464  127 | ,241 | ,209 | ,180 | ,045 | ,013 | ,455 | ,831 | ,488  128 | ,482  127 | ,965 |
| 130 | 130 | 128 | 129 | 127 | 128 | 127 | 127 | 124 | 126 | 128 |
| In-depth education about blockchaintechnologies for ITprofessionals | Pears on Correl ation | ,140 | ,052 | ,251\*\* | ,315\*\*  ,000 | ,063 | 1 | ,255\*\* | ,213\* | ,254\*\* | -,004 | ,020 | ,005 | ,071 | ,183\* | ,083 | ,122 | ,056 | ,163 |
| Sig. (2tailed) | ,111 | ,555 | ,004 | ,476 |  | ,003 | ,016 | ,004 | ,962 | ,821 | ,955 | ,425 | ,041 | ,354 | ,169 | ,533 | ,065 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| and administrativ e-officers in the educationalsector | N | 130 | 131 | 131 | 129 | 129 | 131 | 129 | 128 | 130 | 128 | 129 | 128 | 128 | 125 | 127 | 129 | 128 | 129 |
| The  possibility to process information from various blockchainsystems | Pears on Correl ation | ,179\* | ,114 | ,220\* | ,395\*\*  ,000  128 | ,112 | ,255\*\* | 1 | ,262\*\* | ,162 | -,050 | ,114 | ,087 | ,179\* | ,293\*\* | ,064 | -,006 | ,142 | ,168 |
| Sig. (2tailed) | ,042 | ,197 | ,012 | ,209 | ,003 |  | ,003 | ,066 | ,578 | ,199 | ,333 | ,044 | ,001 | ,475 | ,942 | ,112 | ,058 |
| N | 129 | 130 | 130 | 128 | 129 | 130 | 127 | 129 | 127 | 128 | 127 | 127 | 125 | 126 | 128 | 127 | 128 |
| Clear and transparent rules about who is responsible for payment of fees | Pears on Correl ation | ,065 | ,008 | ,125 | ,124  ,164  127 | ,066 | ,213\* | ,262\*\* | 1 | ,271\*\* | -,129 | ,026 | ,170 | ,105 | ,251\*\* | ,129 | ,103 | -,027 | ,195\* |
| Sig. (2tailed) | ,467 | ,932 | ,157 | ,464 | ,016 | ,003 |  | ,002 | ,151 | ,768 | ,058 | ,243 | ,005 | ,150 | ,248 | ,761 | ,028 |
| N | 128 | 129 | 129 | 127 | 128 | 127 | 129 | 128 | 126 | 127 | 126 | 126 | 123 | 125 | 127 | 126 | 127 |
| Basic information/ education about blockchaintechnologies for all people involved in the educational sector | Pears on Correl ation Sig. (2tailed) | -,120  ,173 | ,075  ,392 | ,133 | ,172  ,052  129 | ,104 | ,254\*\*  ,004 | ,162 | ,271\*\*  ,002 | 1 | -,133 | -,027 | ,084 | ,065 | ,073 | -,078 | -,012  ,896 | -,016  ,854 | ,050 |
| ,129 | ,241 | ,066 |  | ,135 | ,761 | ,343 | ,465 | ,417 | ,381 | ,573 |
| N | 130 | 131 | 131 | 129 | 130 | 129 | 128 | 131 | 128 | 129 | 128 | 128 | 125 | 128 | 129 | 128 | 129 |
| Challenges of blockchain technologies - Weakening traditional school credentials | Pears on Correl ation Sig. (2tailed) | ,220\*  ,013 | -,071  ,423 | -,073 | ,053  ,551  127 | ,112 | -,004  ,962 | -,050 | -,129  ,151 | -,133 | 1 | ,101 | -,085 | ,119 | -,024 | -,111 | ,002  ,985 | ,207\*  ,013 | ,131 |
| ,411 | ,209 | ,578 | ,135 |  | ,228 | ,314 | ,156 | ,777 | ,189 | ,118 |
| N | 128 | 129 | 129 | 127 | 128 | 127 | 126 | 128 | 144 | 144 | 143 | 143 | 140 | 141 | 144 | 143 | 144 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Challenges of blockchain technologies  - Trust | Pears on Correl ation | ,089 | ,107 | ,102 | ,057  ,526  128 | -,119 | ,020 | ,114 | ,026 | -,027 | ,101 | 1 | ,443\*\* | ,101 | ,179\* | ,263\*\* | ,161 | ,418\*\* | ,279\*\* |
| Sig. (2tailed) | ,313 | ,225 | ,247 | ,180 | ,821 | ,199 | ,768 | ,761 | ,228 |  | ,000 | ,230 | ,034 | ,002 | ,053 | ,000 | ,001 |
| N | 129 | 130 | 130 | 128 | 129 | 128 | 127 | 129 | 144 | 145 | 144 | 144 | 141 | 142 | 145 | 144 | 145 |
| Challenges of blockchain technologies  - Privacy &  Security | Pears on Correl ation | ,172 | ,117 | ,073 | ,063  ,483  127 | ,178\* | ,005 | ,087 | ,170 | ,084 | -,085 | ,443\*\* | 1 | ,205\* | ,410\*\* | ,419\*\* | ,361\*\* | ,269\*\* | ,094 |
| Sig. (2tailed) | ,052 | ,186 | ,412 | ,045 | ,955 | ,333 | ,058 | ,343 | ,314 | ,000 |  | ,014 | ,000 | ,000 | ,000 | ,001 | ,262 |
| N | 128 | 129 | 129 | 127 | 128 | 127 | 126 | 128 | 143 | 144 | 144 | 143 | 140 | 141 | 144 | 143 | 144 |
| Challenges of blockchain technologies  - Cost | Pears on Correl ation | ,063 | ,104 | ,178\* | ,057  ,526  127 | ,219\* | ,071 | ,179\* | ,105 | ,065 | ,119 | ,101 | ,205\* | 1 | ,247\*\* | ,205\* | ,159 | ,097 | ,205\* |
| Sig. (2tailed) | ,482 | ,240 | ,044 | ,013 | ,425 | ,044 | ,243 | ,465 | ,156 | ,230 | ,014 |  | ,003 | ,015 | ,057 | ,249 | ,014 |
| N | 128 | 129 | 129 | 127 | 128 | 127 | 126 | 128 | 143 | 144 | 143 | 144 | 140 | 141 | 144 | 143 | 144 |
| Challenges of blockchain  technologies  -  Immutability | Pears on Correl ation | ,111 | ,002 | ,194\* | ,235\*\*  ,008  124 | -,068 | ,183\* | ,293\*\* | ,251\*\* | ,073 | -,024 | ,179\* | ,410\*\* | ,247\*\* | 1 | ,583\*\* | ,446\*\* | ,210\* | ,148 |
| Sig. (2tailed) | ,217 | ,980 | ,030 | ,455 | ,041 | ,001 | ,005 | ,417 | ,777 | ,034 | ,000 | ,003 |  | ,000 | ,000 | ,013 | ,080 |
| N | 125 | 126 | 126 | 124 | 125 | 125 | 123 | 125 | 140 | 141 | 140 | 140 | 141 | 138 | 141 | 140 | 141 |
| Challenges of blockchain technologies - Scalability | Pears on Correl ation | ,155 | ,087 | ,101 | ,037  ,683  126 | -,019 | ,083 | ,064 | ,129 | -,078 | -,111 | ,263\*\* | ,419\*\* | ,205\* | ,583\*\* | 1 | ,525\*\* | ,237\*\* | ,164 |
| Sig. (2tailed) | ,082 | ,329 | ,258 | ,831 | ,354 | ,475 | ,150 | ,381 | ,189 | ,002 | ,000 | ,015 | ,000 |  | ,000 | ,005 | ,051 |
| N | 127 | 128 | 128 | 126 | 127 | 126 | 125 | 128 | 141 | 142 | 141 | 141 | 138 | 142 | 142 | 141 | 142 |
| Challenges of blockchain technologies - Data unavailabilit y | Pears on Correl ation | ,159 | -,071 | ,120 | ,161  ,069  128 | ,062 | ,122 | -,006 | ,103 | -,012 | ,002 | ,161 | ,361\*\* | ,159 | ,446\*\* | ,525\*\* | 1 | ,406\*\* | ,231\*\* |
| Sig. (2tailed) | ,072 | ,421 | ,173 | ,488 | ,169 | ,942 | ,248 | ,896 | ,985 | ,053 | ,000 | ,057 | ,000 | ,000 |  | ,000 | ,005 |
| N | 129 | 130 | 130 | 128 | 129 | 128 | 127 | 129 | 144 | 145 | 144 | 144 | 141 | 142 | 145 | 144 | 145 |
| Challenges of blockchain technologies - Setting the boundaries | Pears on Correl ation | ,072 | ,017 | ,091 | ,044  ,626  127 | -,063 | ,056 | ,142 | -,027 | -,016 | ,207\* | ,418\*\* | ,269\*\* | ,097 | ,210\* | ,237\*\* | ,406\*\* | 1 | ,337\*\* |
| Sig. (2tailed) | ,420 | ,847 | ,304 | ,482 | ,533 | ,112 | ,761 | ,854 | ,013 | ,000 | ,001 | ,249 | ,013 | ,005 | ,000 |  | ,000 |
| N | 128 | 129 | 129 | 127 | 128 | 127 | 126 | 128 | 143 | 144 | 143 | 143 | 140 | 141 | 144 | 144 | 144 |
| Challenges of blockchain technologies - Immaturity | Pears on Correl ation | ,087 | -,030 | ,068 | ,006  ,946  128 | ,004 | ,163 | ,168 | ,195\* | ,050 | ,131 | ,279\*\* | ,094 | ,205\* | ,148 | ,164 | ,231\*\* | ,337\*\* | 1 |
| Sig. (2tailed) | ,326 | ,732 | ,443 | ,965 | ,065 | ,058 | ,028 | ,573 | ,118 | ,001 | ,262 | ,014 | ,080 | ,051 | ,005 | ,000 |  |
| N | 129 | 130 | 130 | 128 | 129 | 128 | 127 | 129 | 144 | 145 | 144 | 144 | 141 | 142 | 145 | 144 | 145 |

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,013 and R = 0,220), between the need to consider "involvement of Government, strict worldwide regulation" before including blockchain technologies in the education sector and weakening traditional school credentials. From this correlation it can be seen that an increase in the need to consider "involvement of Government, strict worldwide regulation" may lead to a small increase in the weakening traditional school credentials.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,044 and R = 0,178), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and cost. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to a small increase in the cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,030 and R = 0,194), between the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" before including blockchain technologies in the education sector and immuability. From this correlation it can be seen that an increase in the need to consider "the ability to get a copy of data that can be stored on node, regardless of which blockchain system was originally used" may lead to a small increase in the immuability.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,008 and R = 0,235), between the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" before including blockchain technologies in the education sector and immuability. From this correlation it can be seen that an increase in the need to consider "the ability to operate a full node and store an encrypted copy of the blockchain used to store credentials" may lead to an increase in the immuability.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,045 and R = 0,178), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and privacy & security. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" may lead to a small increase in the privacy & security.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,013 and R = 0,219), between the need to consider "involving corporations in the process of setting up Blockchain-technologies in the educational sector" before including blockchain technologies in the education sector and cost. From this correlation it can be seen that an increase in the need to consider "involving corporations in the process of setting up blockchain technologies in the educational sector" may lead to a small increase in the cost.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,041 and R = 0,183), between the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" before including blockchain technologies in the education sector and immutability. From this correlation it can be seen that an increase in the need to consider "in-depth education about blockchain technologies for IT-professionals and administrative-officers in the educational-sector" may lead to a small increase in the immutability.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,044 and R = 0,179), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and cost. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to a small increase in the cost.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,001 and R = 0,293), between the need to consider "the possibility to process information from various blockchain-systems" before including blockchain technologies in the education sector and immuability. From this correlation it can be seen that an increase in the need to consider "the possibility to process information from various blockchain-systems" may lead to an increase in the immuability.

There is a reasonably positive correlation, statistically significant at a 99% confidence level (Sig = 0,005 and R = 0,251), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and immuability. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to an increase in the immuability.

There is a weak positive correlation, statistically significant at a 95% confidence level (Sig = 0,028 and R = 0,195), between the need to consider "clear and transparent rules about who is responsible for payment of fees" before including blockchain technologies in the education sector and immaturity. From this correlation it can be seen that an increase in the need to consider "clear and transparent rules about who is responsible for payment of fees" may lead to a small increase in the immaturity.

### 4.3. Synthesis of results vs hypothesis

As can be seen from the previous chapter, there are correlations between the elements of the 5 questions measured on the ordinal scale. Thus, for the 5 hypotheses there are both reasonably positive correlations and weak positive correlations. Also, there is no correlation between some elements.

In order to show the synthesis of the results presented in the previous chapter, 5 figures will be illustrated (one figure for each hypothesis). Each subpoint on the left will be represented by a color. On the right side each subpoint will include the colors of the elements with which there is a correlation.

Figure 4.2 shows the synthesis of hypothesis 1:

**Figure 4.2: Synthesis of hypothesis 1**

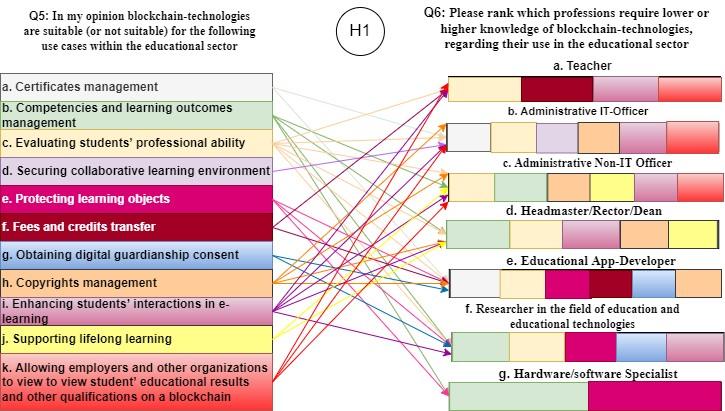


Figure 4.3 shows the synthesis of hypothesis 2:

**Figure 4.3: Synthesis of hypothesis 2**

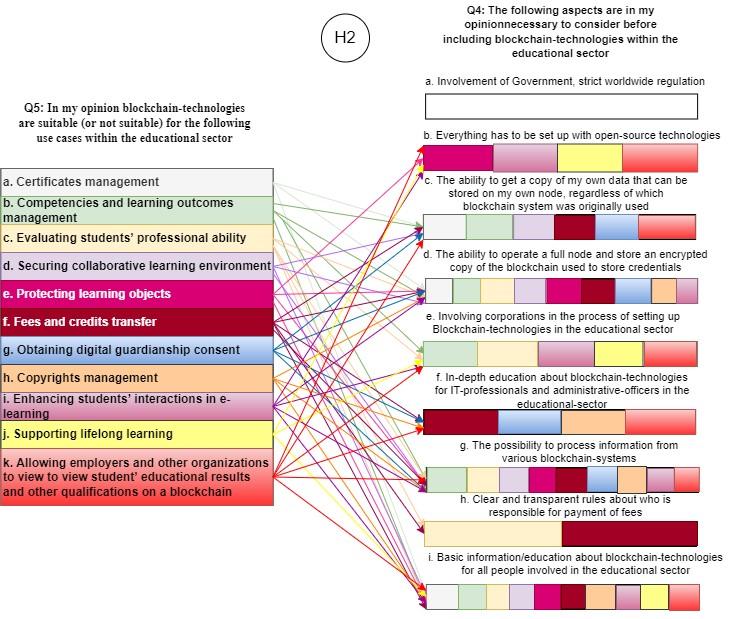


Figure 4.4 shows the synthesis of hypothesis 3:

**Figure 4.4: Synthesis of hypothesis 3**

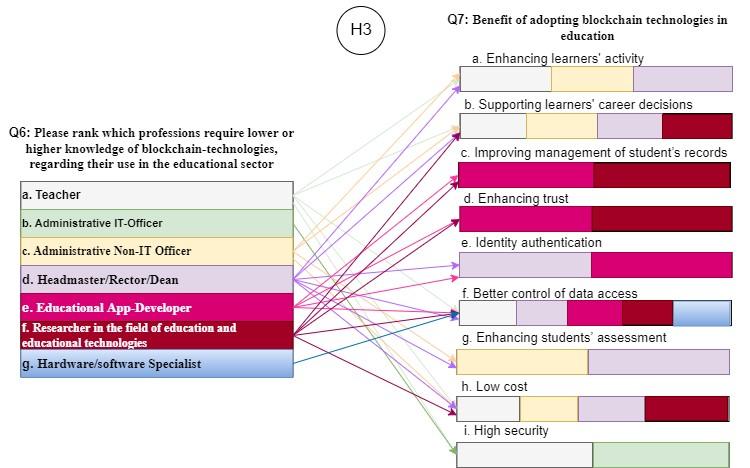


Figure 4.5 shows the synthesis of hypothesis 4:

**Figure 4.5: Synthesis of hypothesis 4**

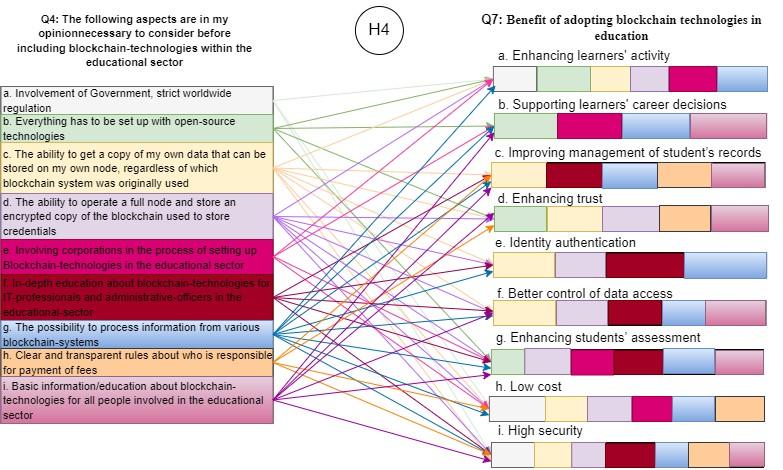
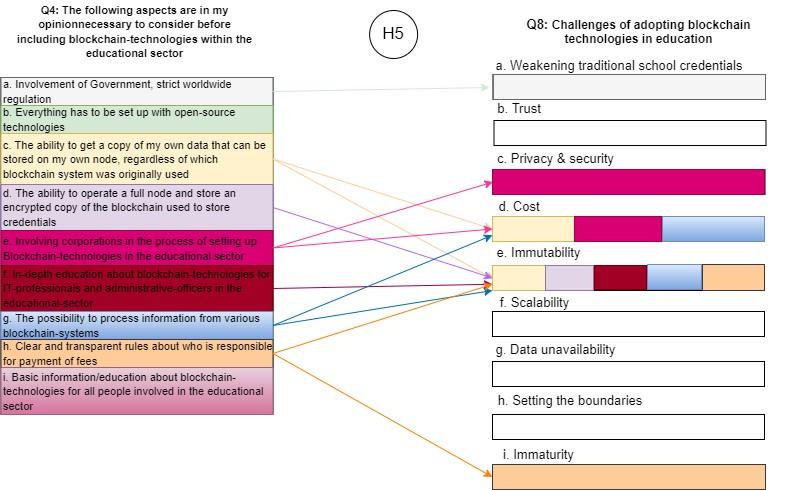


Figure 4.6 shows the synthesis of hypothesis 5:

**Figure 4.6: Synthesis of hypothesis 5**



# 5. Digital Recognition – Uses of Blockchain in Czech Higher Education

## 5.1. Introduction

From a pure technology perspective Blockchain is only a special type of database. However, this would barely describe the overall idea of a Blockchain application. In order to gain a coherent picture of Blockchain technology and its network design it makes sense to distinguish between three different layers: (1) Application Layer, (2) Network Layer, and (3) Technology Layer. Following the design-thinking mode the intended application of Blockchain determines the design of the network and at the same time the selection of the right technology. Previous research on technology adoption typically suggests that there are three classic stages of adopting a new, ground-breaking technology: exploiting a niche, substituting, and then changing the economy. These are, at least, the stages the Internet needed to reach its current development. This process has taken about three decades.

There is currently an ever-growing interest in Blockchain, since this kind of technology has the potential to completely change the way businesses handle, manage, record, validate and verify their transactions. The basic business model is being shifted away from a centralized structure (exchanges, trading platforms) towards decentralized systems (no middlemen, no agencies, direct interaction between consumers). As such, expectations of disruption from Blockchain technology are high and the idea that Blockchain has the potential to redistribute markets and redefine the entire economic system is one that is widely agreed with today. Over the past couple of years more than 2,500 patents have been filed that relate to Blockchain technology and several billion US dollars have been invested in Blockchain start-ups. A World Economic Forum survey of 800 executives and experts from the information and communications technology sector predicted that, by 2025, 10% of global GDP would be stored on Blockchains or Blockchain related technology (**Espinal**, O’Halloran, Brynjolfsson, & O’Sullivan, 2015). It is no surprise then that Blockchain has emerged as the hot new topic and as a key technology that will transform the way in which we share information. Just like the Internet, Blockchain makes use of existing technologies to create new and innovative usages and enable novel business models in a wide range of sectors.

Blockchain can be effectively used for certifying network inventory (equipment, devices, status, **repositioning**, maintenance operations history, **etc.**) by sharing a ledger between all participants along the value chain (energy operators, dealers, supervisory authorities). In this way, parts needing to be replaced can be easily identified and the authenticity of spare parts can be verified. Blocs & Compagnie is a French start-up offering auditing solutions for any internal and external enterprise business process by proposing a Blockchain enabled, cloud-based, Enterprise Content Management Solution as a service. It is important to have a traceability system that can monitor and collect in a rigorous way all the information relating to the displacement of different items along the energy supply chain. The start-up **Crypto Seal** offers a Blockchain-based solution for the outdated wax seal by using a chip that exactly tracks the course of an energy product, from production to disposal. The chip contains identification data which is recorded and verified by Blockchain. By sharing data between stakeholders, customs clearance for imported products, such as petrol, can be simplified as well.

Digital transformation and in particular distributed ledger technology have fundamentally changed the landscape of higher education as well and will continue to do so. A provider of higher education is affected by digital transformation in three ways: First and foremost, of course, in the educational content, the structure of study programs and the didactic method of imparting knowledge. Secondly, the education provider is itself an organization with processes and is thus directly subject to digital change. Thirdly, the provider acts as a change agent for the regional community and collaborates with others in national and international research and education networks.

Regardless of the field of study, each graduate is expected to have knowledge of the functioning of new digital technologies and a sound understanding of the advantages and risks of using new technologies. In addition to IT skills, students need to learn the psychology of **behavioral** change and communication. This is because knowledge of change management will become indispensable for successfully shaping the transformation process of organizations. As a result, the future study programme will clearly increase in the interdisciplinarity of the taught content. The didactics of teaching will change fundamentally: the times in which the professor had a monopoly on a certain knowledge segment are finally over. The knowledge itself is available in all possible foreign languages and forms on the Internet. What is missing is the coach, who shows the student an individual educational path structured according to her or his needs and abilities. The interactive coaching of students using all available channels will replace the communicative one-way street of the traditional lecture in the lecture hall. This does not mean that the physical meeting of teacher and student will lose its importance. On the contrary, face-to-face meetings with professors are gaining intensity as they are quality time within a blended learning environment of video tutorials, virtual classrooms and webinars.

As an organization, universities must question whether their processes are optimally structured in such a way that the overriding goal of providing the student with an optimal education as a user of the organization is achieved. Both the educational program as well as the organization of education must be geared to the changed requirements of digital transformation, otherwise the overall package of education will not be consistent and coherent. But are today’s universities sustainable **organizations** in terms of using scarce **taxpayers**' money efficiently to educate students? If one looks at the mostly oversized buildings of universities with the multitude of less-used offices of professors, one gets the impression that the age of purely physical and centralized knowledge transfer still prevails here. The lecturer’s work is still counted in contact hours of teaching done per week per semester. Universities are still **organizationally** divided into faculties, which makes the interdisciplinary **organization** of joint study **programs**, workshops, research projects or conferences much more difficult. The same applies to the university administration, whose processes are mostly still paper-based and strictly hierarchically organized. Administration staff of universities often outnumber faculty members, which indicates a skewed allocation of resources. Distributed ledger technology will decentralize the organization of education. The students become sovereign to their private data, including their education data. Equipped with their own identity, students will manage their grades as well as their ECTS points. In the future, the respective lecturer will send both the grade and the ECTS points to the student as part of the network and this information will be automatically validated and irreversibly stored in the Blockchain. The examination office is also a node of the network and thus simultaneously obtains the same information about the student's course studies. Certificates will be sent directly to the student via smart contract applications and stored in the Blockchain when the required number of credit points is reached (Grech & Camilleri, 2017, p. 33). A central repository of student grades at the university’s examination office and a central registration of students’ private data at the university’s admission office will become obsolete. The dematerialization and decentralization of the "university" organization may go even further. In the future, students could enroll for individual modules or for a course of study via a web-based platform, whereby data management is based on blockchain peer-to-peer. Students could also take courses from partner universities, regardless of their location, as the exchange and recognition of credit points is just as decentralized via Blockchain as with their own modules. In the case of blended learning modules, a constant presence of the students on site is not necessary anyway, so that the students and the lecturer could meet only when required at logistically optimal locations. In future, the tasks of an educational organization will lie primarily in ensuring the quality of education, in advising and coaching learners and in its role as a service provider. Education for its own value and individual learning processes do not require such large "production sites" as universities. Blockchain enables much closer cooperation between university teaching and research and between universities and the corporate world. The diffusion process of innovations such as Distributed Ledger Technology into academic teaching as well as into the working world must be significantly shortened, which means that the boundaries between studying and working must merge more strongly. The same applies to lecturers, who are constantly switching jobs between the real economy and academies. The university as a provider of education must develop a self-understanding that a central task of a public educational institution is to be the driver or motor for social innovation in the community.

## 5.2. Research Methodology and Sampling

From a theoretical perspective, the potential of Blockchain technology is recognized throughout the industry. However, very little research has gone beyond conceptual considerations of the benefits offered by Blockchain technology for the educational sector. This paper attempts to address the lack of insights in research by examining the perception from the perspective of future users of Blockchain technology in education, namely students on various study levels.

The study explicitly addresses the following research questions:

RQ1: What is the knowledge of Blockchain technology related towards educational sector?

RQ2: What are the aspects influencing implementation of Blockchain technology into the

educational sector?

RQ3: What are the areas suitable for implementing of Blockchain technology into the

educational sector?

Regarding data collection, the questionnaires in online format were used as a method to answer the research questions. The research sample consisted of 147 students of business and management studies at bachelor, master, and doctoral level. Regarding gender structure, the sample consisted of 79 men, 67 women and 1 respondent stated other type of gender without specification.

Data was collected from September till November 2022.

## 5.3. Results and Discussion

This section provides the shared benefits of the Blockchain technology application for the educational sector. The results and discussion section is deliberated in the following section.

For answering the research question of revealing recent knowledge and for more comprehensive understanding of the Blockchain technology by future managers, the analysis of gained data from written questionnaires were undertaken. The obtained research results were analysed by means of descriptive statistics and content analysis of qualitative data gained from open questions.

In the following figures are introduced and visualised the outcomes of data analysis.

Based on the research results we can see that our respondents are familiar with the concept of the Blockchain, because just two of them have never heard about this type of technology. From the gained data we can see that awareness of this technology has been systematically increased since 2014 when some of them have stated to hear about this technology for a first time.

Further, our intention was to explore what kind of knowledge related to this technology our respondents possess. Their answers are visualised in the Figure 1.

***Figure 5.1. Respondents´ knowledge towards Blockchain technology (Source: own research)***

As shown in the Figure 2, we can see that the possessed knowledge in the context of Blockchain technology is generally very good. There are no areas connected to the Blockchain technology which would be totally unknown for our respondents. The most respondents´ associations in this context were related with digital wallet (133 positive responses), followed by public address (124 responses), private key (117 responses), transaction fees (114 responses) and mining (113 responses). On the other hand, the least awareness was identified with the items like decentralized storage (29 responses), Blockchain bloat (40 responses), hash table (42 responses) or hash power (53 responses). We discovered contrasts as well in answers based on respondents´ gender. The most significant discrepancies were identified by possessed knowledge related with oracles, Blockchain bloat, cryptographic hash function or Blockchain fork where males´ knowledge prevails over the females´ one. On contrary, by the terms of mining, wallets, decentralized storage, or smart contracts were females’ knowledge higher than by males’ counterparts. By the item of multi signatures we could observe similar knowledge by all genders.

In the following figure is displayed respondents´ knowledge of blockchain technology respondents correlated with the level of their study.

**Figure 5.2. Respondents´ knowledge of Blockchain correlated with study level (Source: own research)**

Based on the research data, the respondents´ knowledge of Blockchain is connected mostly with digital wallets, transaction fees, public address, and private key, mining, and decentralised storage. The least known areas are oracles, Blockchain bloat, hash table, Blockchain fork or hash power. When we investigate the data more in detail and correlate the knowledge of students determined by their study level, than we see that master students are the most informed ones in this area in comparison with bachelor and doctoral students. Having analysed the students´ knowledge on study levels we can observe that bachelor students associate Blockchain technology at most with digital wallets, public address, private key, transaction fees and mining. Looking at knowledge content by students on master level, it is obvious similar tendency like by bachelor students, however with slight differences in their order. The master students demonstrate their knowledge in the context of Blockchain in following order – digital wallets, transaction fees, mining, public address, and private key. As well students on the doctoral level marked similar items like students on lower levels known for them. However, for PhD candidates were some of the areas totally unknown. There was no knowledge detected for oracles, hash power, hash table, Blockchain fork and Blockchain bloat.

**Figure 5.4. Aspects to be considered before Blockchain implementation (Source: own research)**

We can see in Figure 3 which aspects perceive our respondents as very important to be considered before implementation of Blockchain technology into the higher educational processes and agendas. As the most crucial seems to be “clear and transparent rules about who is responsible for payment of fees” (97 responses), followed by “basic information/education about Blockchain-technologies for all people involved in the educational sector” (95 responses), “in-depth education about Blockchain-technologies for IT-professionals and administrative-officers in the educational-sector” (85 responses), “the ability to get a copy of my own data that can be stored on my own node, regardless of which Blockchain system was originally used” (82 responses). As the less important are seen the items “the ability to operate a full node and store an encrypted copy of the Blockchain used to store credentials”, “involving corporations in the process of setting up Blockchain-technologies in the educational sector” and “involvement of Government, strict worldwide regulation”.

In the following part we can see how Blockchain technology is viewed as suitable (or not suitable) for some selected areas within the educational sector.

Figure 4. Areas suitable for Blockchain Implementation within the Educational sector (Source: own research)

As the most suitable for applying Blockchain technology into the educational processes are perceived fields of “fees and credits transfer” (96 responses), “copyrights management” (80 responses), “supporting lifelong learning” (72 responses), “protecting learning objects” (66 responses) and “evaluating students’ professional ability” + “certificates management” (with the same amount of 63 responses). As the least suitable are seen the areas of “securing collaborative learning environment” and “enhancing students’ interactions in e-learning”.

## 5.3. Conclusion

Our main attention was paid towards revealing of awareness and knowledge of Blockchain like modern technology in the context of educational processes in the Czech environment. Based on literature review and gained empirical data it seems that Blockchain as a disruptive technology that provides unprecedented levels of security, can be perceived in general like a very adaptable in various areas. Moreover, in the educational sector were identified advantages related to usage of this technology like higher accuracy of transactions, no need for intermediaries, security, efficient transfers, decentralization, resistance, and resilience perceived like very beneficial.

Exploring the data towards the first research question “What is the knowledge of Blockchain technology related towards educational sector?”, we can conclude that our respondents are familiar with the concept of the Blockchain and that their awareness and knowledge concerning to this technology has been systematically increased since 2014 when some of them have stated to hear about this technology for a first time. Looking at respondents’ associations more in detail in the context of Blockchain, they mentioned mostly digital wallet, public address, private key, transaction fees and mining. On the other hand, they were the least aware about oracle, Blockchain bloat, hash table and hash power.

In the second part we have tried to find out which aspects influence implementation of Blockchain technology into the educational sector. And, according to our respondents it seems that very important is clarity and transparency of rules and basic information/education about Blockchain technology is very important for all people involved in the educational sector.

In finding answer towards the question which areas are perceived as suitable for implementing of Blockchain technology in education, our respondents concurred that fees and credits transfer, copyrights management and supporting lifelong learning are most suited for implementation of this modern technology. On contrary, they determined as least suitable securing collaborative learning environment and enhancing students’ interactions in e-learning. This research has several limitations, which should be considered. Researchers collected data via online questionnaires with a certain number of respondents. For future studies, it is advisable to enlarge the sample size of the empirical research to produce a more comprehensive analysis. Moreover, the findings can be extended in the future by considering of involving more countries or sectors so as to realize a comparison in various environments which can represent a base for starting potential cooperation with the option of mutual compatibility in strategic solutions.

# 6. Digital Recognition – Uses of Blockchain in Norway

## 6.1. Introduction

As part of the BOOST EDU project, a section under the label Intellectual Output 2 requires a country-by-country report on the uses and potentials of blockchain in education. This brief memo is a response to the requirement, based on the observation that the countries participating in this study are widely different, with Norway like the other Nordic countries not being in that category where Blockchain answers particularly to the overall institutional aspects of access to education and ownership of personal data. These are complex issues, requiring more than a brief memo. Accordingly, just a few highlights are introduced here.

##### On Blockchain

Blockchain as a technology is quite well described in the report from the IO2 team in this project. It is noted how Blockchain technology is commonly associated with the emergence of Bitcoin, and – one might also assume – with the reputational hit that Bitcoin currency has taken in the past year. Be that as it may, the main concern here is to move beyond those lines to what it is that is at stake for education.

The first issue is *decentralization*: A common feature of any secure system that curates personal and otherwise sensitive information, is *safety of preservation* and *transparency* concerning the rules that govern it. Commonly, institutions of higher education store student and staff data on a variety of levels, one of these being grades, degrees, courses taken and other career–defining information.

As society changes and decentralization becomes more of a fact everywhere, one sees how industries like the film industry, or the music industry begin to move data in new ways and for new purposes. Large monopolies failed and new ones came on the scene: Tower Records go down and up comes Spotify. The Tower Records experience was on of walking into a store and browsing the shelves, whereas the Spotify experience is one of a tailor-made system of preferences where Artificial Intelligence algorithms sort out massive information to come up with a portfolio of one singular person: YOU. This is the future of streaming across society´s diverse ranges of information flows. And one assumes that somehow and at some time it will also become a cornerstone of education and learning institutions. Already one sees signs of these things in for instance such institutions as Udacity, Coursera and other MOOC platforms that Taylor courses to the needs of individuals or cohorts of individuals based on massive scaling.

Here is essentially the challenge for universities and other institutions of higher education. The two interviews presented by the University of Adger team amply illustrate the phenomenon. Decentralization is a key component in today´s technology. And with it follows new means of re-centralization. The question is at what level? When technology allows students to own their own education and career data, curating them in new ways and for instance borne by blockchains; should they? What kinds of issues does this raise? What institutional concerns and what are the implications concerning ideologies pertaining to higher education and learning?

The two interviews we presented come from the front-end of world development in these areas. Phil Komarny is currently working to re-design Maryville University of St. Lous, in the US, to implement a more custom-tailored approach to student enrollment and routine everyday life on campus. Donna Kidwell is playing a related role at Arizona State University, USA. Both of them have been active in projects and conferences in Norway, which is why it is a likely choice to talk to these to.

The second issue and the center issue of these interviews is the question of *data ownership*. As data generally flows faster and more encompassing, personal ownership rights take on a new meaning. A more flexible and decentralized approach to information/Ydata curation comes parallel to new concerns with use and abuse of such data. Blockchain promises to represent a decentralized BUT SAFE data transfer and storage. The networking aspect is a natural maturation of a philosophy that once began with the thinking decentralized information networks in the context of the COLD WAR: Not just one, but a myriad, of computer clusters would be a better defense than any single or a few mega-centers. And while much can be said about it, the digital transformation only came to higher education institutions in recent years. Which is another way of saying that these are technological options very much in their infancy. Therefore, any serious usage as a comprehensive mechanism in higher education is – as of today – I believe, premature. But it is perhaps only one opinion.

## 6.2. The challenge

Returning to this project, a response to the baseline question set forth would be that on most levels of relevance, institutions of higher education in the Nordic countries would not be a likely arena for a broad roll-out of blockchain based information processing. What seems more interesting in the two interviews presented is the reflection on how different the US conditions are compared to the ones in the Nordic countries: Less institutionalized int the US, more variation between the various states, and more variation from community colleges to Ivy League institutions. It may well be that a blockchain based system would warrant attention on that note. The size of institutions and the variation in student population would also seem to suggest that pursuing a deep conversation about who owns student data makes sense. One aspect is access to education and what counts as accepted documentation. Another aspect is what counts as standards in a system where there are many, and where education for some might stretch out over many, many years. While those issues have parallels in Norway and the other Nordic countries, the context is entirely different, which makes the deployment of a quantitative survey somewhat problematic unless it begins by observing that difference.

In Norway, there is a system in place where everyone seeking entry to higher education applied through a national process and platform. That by and large means that data standards, ownership and transferability is institutionalized and deeply embedded. To think of the relevance of blockchain in any way as an alternative, is rendered meaningless. It would be a nationally governed change, no matter what change might come.

Once within the system, there is a nationally standardized use of learning management systems, with all the requirements and procurements that this entails. Standards are saet and fixed. As to assessment and standardization of courses and modules, the Bologna process long ago set the framework for this, rendering the use of blockchain pretty much a side issue.

## 6.3. Summary comment

This is of course not to say that understanding blockchain is any less important, teaching it, or making use of it on a lover level of institutional generality. However, what it does imply is that digital recognition – which is of course hugely important – ought to be seen and understood in a different way and a different light: If the case is that students are screened for relevance and qualification in a nationally defined system, my sense is that blockchain is better understood as a nascent technology that sometime in the future might play a role that is difficult to understand today, and in today´s academic world may play a more minor role – one of less urgency.

What seems more urgent is whether and how blockchain-related challenges could be meaningfully brought into the light in terms of how countries with highly standardized data ledgers cooperate on Education with countries that do not. There might well be a consensus in this project that blockchain could serve as a catalyst for such comparison, but it is not something that has been discussed in our meetings.

# 7. Digital Recognition – Uses of Blockchain in Iceland

## 7.1 Introduction

In this report, two potential applications from within education and training are explored. Both are at nascent stages and have not been implemented (or even prototyped) in an Icelandic context, but the ideas show some promise even at this early stage.

## 7.2. History of Blockchain

Blockchains have been around for a number of years. Their origin within computer science can be traced back to the eighties, but interest and activity around the technology surged, following the advent of bitcoin in 2008. Cryptocurrencies have become a world of their own, and for many they are what first comes to mind when blockchains are mentioned. But blockchains may have other applications, and the technology is still developing quite fast, entering new markets of areas of interest. Some call it a breakthrough, as disruptive or important as the internet. Meanwhile others are still skeptical, noting that the technology is still maturing, and its diffusion is hindered by the complexity of implementing blockchain applications, and getting stakeholders on board.

Usage and knowledge within education in Iceland, the case of student registries

For the purposes of BoostEdu’ s study on digital education recognition, and the use of blockchains in the context of education, we have both done desk research and interviews with experts. During our qualitative research on the matter, an idea that regularly came up was the one that students’ records, whether they are for registrations, enrollment, or academic achievements, are typical of data that could be stored on a blockchain. Students regularly need to access this data, namely when they have to certify some are all of their degrees. This can be as part of a job application or when applying for further studies.

Pelletier wrote in 2018, that a few universities had already started experimenting with using blockchains to verify the credentials of students. The hope has been that this technology brings about efficiency, as services such as student registry offices become more automated. There is also hope that widespread use of the technology can solve the problem of forgery.

Some research and piloting in this area has taken place internationally, and on this topic, Ocheja et.al (2022) note that;

“Different institutes often adopt different technologies to manage academic records and issue credentials. This heterogeneity of systems across schools makes it difficult for students to import their learning data from one school to another in a tamper-proof and protected environment. Also, instant verification of academic credentials becomes more complicated as each credential must be validated against a set of rules defined by each school through the specific interfaces provided by such schools or the consortium they belong to. Consequently, it becomes desirable to solve these problems: how can schools easily connect and exchange information with little or no change to internal technology setup while maintaining trust and tamper-proof records management? This is one scenario where the blockchain fits as a solution in education.”

If the data is stored on a blockchain, students can extract verified records of the learning achievements and share them with whomever they choose, thereby simplifying the day-by-day services of European student registries. When universities add records to a shared ledger of this sort, it also facilitates the flow of students from university to another, simplifying tasks such as evaluating learning achievements and degrees across borders.

## 7.3. A potential application of blockchains, being developed at Bifröst University.

A second use case uncovered within Bifröst University, was the application of blockchains, to govern the work and decision making of collectives that have agreed on some form of democratic member control. A well-known case of this is cooperatives, which differ from traditional organizations in that they place particularly high importance on active involvement of all members in decision making that affects the group. Bifröst University is currently developing an entrepreneurship curriculum that focuses on the opportunities that cooperatives bring to the development of new ventures. Cooperatives are an example of an area where blockchain technology has unexpectedly started flourishing. One of the challenges that cooperatives face, in particular when they run on online platforms (see Platform Cooperatives) is how to confirm the identity of members and how to ensure the integrity of voting procedures.

The COPE learning model, developed through an Erasmus+ Strategic Partnership project (www.cope.one) is constructed around a fairly classical curriculum of entrepreneurship education. But for each specific module within the curriculum, an approach drawing from decentralized or cooperative organizational models is proposed, including its rationale, teaching method and support material for trainers or teachers. The COPE model is being developed at Bifröst University, in partnership with 6 other partner organizations who all are involved in regional development, upskilling and training.

Decentralized organizational models are gaining popularity for many reasons. Innovations brought on by blockchain technologies and cryptocurrencies make new ways of organizing partnership democratically and transparently, irrespective of geographic position or nationalities. Collectives of individuals find common ground within cultural, social or political spheres, and being distraught with the power and influence wielded by the big tech and social media companies, are experimenting on a large scale with decentralizing traditional organizational structures. A somewhat unexpected outcome of buoyant activity and experimentation within blockchain technologies and cryptocurrencies has been the reinvigoration of cooperatives.

The COPE learning module supports entrepreneurs in starting new ventures within the social economy. The main novelty of COPE is a focus on cooperative or decentralized ways of solving challenges, supporting growth and sustainability of actions initiated within the social economy.

The rationale for making impact with the COPE learning module, is to approach trainers and advisors within regions and municipalities directly, as those are then in a position to channel the ideas further, to entrepreneurs, collectives or community leaders. Trainers and advisors are often brokers of new projects and partnerships. As they promote or even manage funding and public support schemes, they are a contact point for agents within regions, direct stakeholders tackling challenges, whether they are social, or business related. So, with trainers and advisors and first points of contact, the cooperative model can gain traction throughout regions or among disparate groups facing common challenges.

Applying a blockchain approach to a cooperative, is a way to maintain a verifiable register of members, and to allow the cooperative to be governed by its members through democratic decision making that has integrity and transparency.

## 7.4. Final thoughts and conclusion

On European level, the vision towards the future is to increase cooperation and integration of the education systems of the EU. This push for integration is apparent in the European Universities initiative and other initiative worth noting is Erasmus without paper , that aims to streamline the flow of information that is necessary to realize mobilities of students within Europe. Both of these challenges of EU are good examples where blockchains might be a part of the solution.

Blockchains are still developing, the technology is complex. Seeing them grow into previously unexplored territories, such as cryptocurrencies, is one thing. The engineering and mathematics know-how needed to get involved in that work set a barrier for many. Integrating them into the general systems of our society is another thing. Our institutions and organizations are set in their ways, and even if one can demonstrate clear and obvious benefit from adopting a blockchain based solution for a given problem, this will now happen with a top-down approach. A coordinated effort is needed.

# 8. Development of a pilot model using blockchain concept for “record keeping” of student’ degrees, certificates and diplomas based on the previous analysis. Simulation of a case study

In a pilot model using blockchain concept for ―record keeping‖ of student’ degrees, certificates and diplomas exists:

1. Inputs:
   * personal data,
   * diplomas and certificates.
2. Outputs:
   * hash of identity stored on blockchain,
   * hash of certificate stored on blockchain.

Figure 5.1 shows a pilot model for ―record keeping‖ of student’ degrees, certificates and diplomas:

**Figura 8.1: Pilot model**

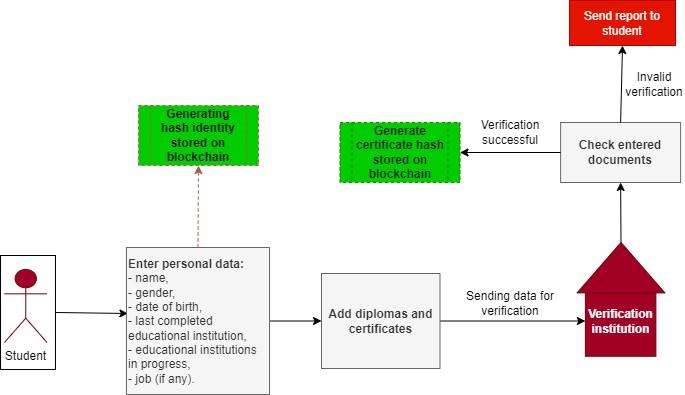
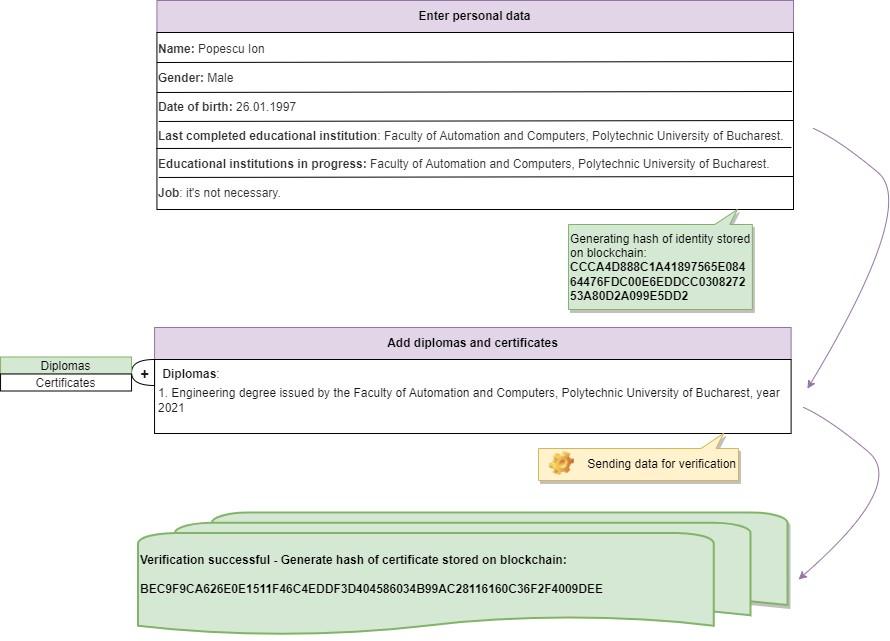


Figure 7.2 shows the simulation of a case study:

**Figure 8.2: Simulation of a case study**



# 9. Conclusions: a common framework of a European Digital Education Recognition solution

The Blockchain is a distributed database or public ledger that stores a list of all digital events or transactions that have occurred and is fundamentally shared among all participants. Only if the majority of the participating parties decide, a transaction can be valid. Due to the wide range of interests in Blockchain applications, the technology is divided into four categories: public, private, hybrid and consortium.

Blockchain technology is perfect for securing, sharing, and verifying learning achievements as a new infrastructure. In the case of certificates, a blockchain can maintain a list of the certificate's issuer and receiver, as well as the document signature (hash), in a public database (the blockchain) that is replicated on thousands of computers all over the world.

Blockchain technology are likely to be tested by the majority of EU member states. Others are developing national strategy, while others are testing specialized applications. In addition to the concerns already revealed, there are a few barriers to blockchain adoption in the education sector. In Romania the digitalization of education sector by using Blockchain is still at the proposal level. They intend to use the Blockchain technology for the digital Certificates, Diplomas, for protecting personal data for university/schools. Moreover, it is planned to use the EBSI (European Blockchain Services Infrastructure).

Regarding the case study presented, it can be seen that all 5 hypotheses are validated. Thus, it can be said that a first link is between the use of blockchain technologies in the education sector and the need for blockchain knowledge in different professions. A second link is between the issues to be considered before including blockchain technologies in the education sector and the use of blockchain technologies. The third link is the knowledge of blockchain technologies in different professions and the benefits of adopting blockchain technologies. The fourth link is between the issues to be considered before including blockchain technologies in the education sector and the benefits of adopting blockchain technologies, but also a link between these issues and the challenges of adopting blockchain technologies in the fifth hypothesis. Thus, the different sub-points that constitute the elements of the hypothesis are influenced by the existence of different reasonable correlations, but also weaker correlations.

Given the 7 interviews with experts, they mention many reasons for using the blockchain in education, including: security and transparency, functionality, novelty, decentralization (unlike traditional database systems which store information on a central server), distributed and scalable, data immutability and integrity, accessibility and availability of data depending on users’ rights (authority), record-keeping uses such as digital credentials and intellectual property management, streamlining of diploma verification.

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