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Investigating the level of awareness of blockchain technology in higher education

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Abstract

This study presents the results of an exploratory study investigating the current level of awareness of blockchain technology among IT administrative staff and educators in the context of higher education in Sweden, by employing a qualitative method for data collection. This study has gained useful insight and perspective of participants' level of understanding of blockchain technology in the context of higher education.

The results demonstrate varied awareness levels of participants by highlighting the level of understanding about blockchain technology and their attitude towards acceptance of it. The study also sheds some light on the challenges associated with blockchain from the perspective of the participants. The study has tried to identify viable solutions to improve the acceptance and gradual adoption of blockchain technology in higher education.

In conclusion, the results indicate that existing frameworks like the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) could be extended by adding a perception of cost to understand the acceptance and adoption of blockchain technology in the context of higher education. Further research is required to investigate the importance of cost perspective to UTAUT and TAM models and its relevance in the context of blockchain technology in higher education. Furthermore, the study suggests that addressing the knowledge gap by producing and distributing educational resources and programs focused on blockchain technology could raise the awareness level and understanding among various stakeholders in higher education which will help in the gradual adoption of blockchain technology in higher education.

Keywords: Blockchain Technology, Awareness, Application, Higher education, Blockchain in higher education, UTAUT, TAM, TF.

Preface

I would like to express my heartfelt appreciation to everyone who helped make the successful completion of this thesis.

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I would also like to acknowledge and thank the research participants for their willingness to participate in this study. I am also appreciative of their thoughtful contributions to the conversations. Your excitement and motivation are a regular source of inspiration.

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Foreword

List of abbreviations

- PoW: Proof of Work
- PoS: Proof of Stake
- IPFS: Interplanetary File System.
- DApp: Decentralized Application.
- HEIs: Higher Education Institutions.
- TAM: Technology Acceptance Model.
- UTAUT: The Unified Theory of Acceptance and Use of Technology.
- TF: Technological framework.
- IPFS: Inter Planetary File System.
- VerDe: Verified Degrees.
- GDPR: General Data Protection Regulation.
- ECTX: European credit transfer and accumulation system.

Definitions

Block: The information or data is stored in the form of blocks in a blockchain it also contains a cryptographic hash of the previous block.

Cryptographic hash: Cryptographic hash or hash function generates a unique hash number based on the data stored in the blocks, which is a unique identifier for each block.

Consensus: The process of consensus in blockchain is once a transaction is made it needs to be authorized and approved by the network participants for which commonly two mechanisms are used PoW and PoS (Mohammad & Vargas, 2022).

Decentralization: In contrast to the centralized database the authority of approving a node's transaction is given to the participants in the network.

Immutability: Once the data is stored in the block it cannot be modified (Delgado-Von-eitzen et al., 2021).

Timestamped: Each block in the blockchain network is timestamped, which means when the node has been created or the transaction occurs.

1 Introduction

In the field of education Blockchain technology can play a significant role (Alipour et al., 2022). Educational technology is extending beyond conventional software and hardware tools to incorporate cutting-edge innovations like blockchain, social media, tangibles, robots and virtual and augmented reality (Alipour et al., 2022). Blockchain technology can create an entire transcript, that includes learning objectives and results as well as student accomplishments and academic credentials (Alipour et al., 2022). Apart from which Degree scams can be reduced with the help of blockchain technology (Alipour et al., 2022). It is believed blockchain technology can address a lot more problems and has a lot more potential in education than these (Alipour et al., 2022).

As educational technology advances and embraces new innovations, it is more crucial than ever to protect the sensitive data created by these systems. The world of technology is developing rapidly, so preserving data security has grown to be a top priority (Majdoubi et al., 2022). The increased popularity of Internet of Things (IoT) due to its innovative services and integration of Artificial intelligence, Edge/cloud, 5G, machine learning and big data analytics with IoT has created smart systems which generate sensitive data (Majdoubi et al., 2022), which has created necessity for a robust security measure. To enhance the data security blockchain technology has been explored in various field including healthcare, education, financial sectors (Delgado-Von-eitzen et al., 2021).

The immutability, transparency, and decentralization nature of blockchain, along with its cryptographic features, offer the way to tamper-proof and secure data transactions (Deepashika & Seneviratne, 2022). Which has led to its growing popularity in recent years in business settings (Deepashika & Seneviratne, 2022) where blockchain technology has improved trading expenses, increased transaction auditability, quicker transaction settlement, and more effective monitoring (Deepashika & Seneviratne, 2022).

It is believed that Higher Education Institutions (HEIs) can be benefited from adopting blockchain technology with its decentralized nature which provides security, verifiability, immutability (Ma & Fang, 2020), and transparency for information and data storage (Panagiotidis, 2022). Since 2017, there has been increased interest in exploring these benefits in the sector of higher education (Mohammad & Vargas, 2022). By adopting blockchain technology HEIs can secure student records and other academic information which can be tamper-proof and immutable (Delgado-Von-eitzen et al., 2021).

Blockchain technology is believed to have the potential to assist educational institutions

in a variety of ways (Mohammad & Vargas, 2022). One benefit is considered to be by reducing time-consuming and costly formalities, the method for internationalizing higher-education institutions through student exchanges or collaborative programs can be streamlined. Another benefit is believed to be the "blockchain-based gamification of learning", which would simplify the management of granted certifications (Mohammad & Vargas, 2022).

The potential benefits and challenges of using blockchain technology in various sectors, including education, have been a topic of interest for numerous scholars, resulting in a growing body of literature in the field (Delgado-Von-eitzen et al., 2021). However, the adoption of blockchain technology in higher educational institutions has been limited at present (Mohammad & Vargas, 2022). This can be attributed to the technology's nascent stage, which faces technical hurdles such as poor usability, scalability, and security, as well as non-technical barriers such as a shortage of specialists, skilled blockchain engineers, and financial constraints (Ma & Fang, 2020).

While there is a growing body of literature on blockchain technology in higher education (Delgado-Von-eitzen et al., 2021), there is a limited understanding of the level of awareness (Lam & Dongol, 2022) among educators and IT administrative staff. This knowledge gap is critical for addressing the current limited adoption of blockchain in HEIs. Because of their crucial roles in setting up the technological landscape within universities, understanding the level of awareness among educators and IT administrative staff is critical. Educators have the power to drive the adoption of specific technologies through their research methodologies and pedagogical approaches. IT administrative professionals, on the other hand, are in charge of making judgments about the technology used in educational institutions. To ensure the successful integration of technology in any domain, it is crucial to not only focus on technical expertise but also to evaluate the awareness and understanding of the technology among its potential users or beneficiaries.

This paper aims to find the level of awareness about blockchain technology among academic scholars and IT administrative staff. To also investigate the level of awareness of the general areas where blockchain technology can be used effectively. Consequently, setting a foundation for the eventual adoption of blockchain by addressing the need and ways to increase awareness.

2 Background

2.1 Problem Statement

The adoption of blockchain technology in HEIs is slow (Mohammad & Vargas, 2022) as illustrated in Table 1, despite it has been argued to have potential benefits emphasized by various literatures and various research proposals and solutions to use blockchain in higher education. While blockchain has received considerable attention from various fields like healthcare, finance and education, its implementation in HEIs at present very limited. One of the possible explanations for this could be the lack of awareness of blockchain technology among the potential stakeholders in higher education.

These stakeholders in higher education include Educators, IT administrative staff, administrators, students, and researchers. These stakeholders' awareness and comprehension of blockchain technology is critical because they play an important role in curriculum design, technology implementation, decision-making, student expectations, research activities, and collaborations. Evaluating the level of awareness of these stakeholders is critical in bridging the knowledge gap and eliminating hurdles to effectively promote blockchain technology integration in higher education.

In addition to this the level of understanding of blockchain technology among IT administrative staff and educators in higher education is still unclear. This knowledge gap is vital to comprehend the technology's slow acceptance by HEIs, and there is still a scarcity of articles about blockchain awareness in context of higher education. Therefore, it is necessary to Investigate the current level of awareness and understanding of blockchain technology among IT administrative staff and educator in higher education to identify the factors influencing the non-adoption and provide steps to be taken to for eventual adoption.

2.2 Purpose and Aim

The main objective of this study is to investigate the level of awareness about blockchain technology among IT administrative staff and educators in higher education. It is also to investigate the steps which could be taken to educate about blockchain technology among all stakeholders in HEIs. Consequently, setting a foundation for the eventual adoption of blockchain by addressing the need and ways to increase awareness.

2.3 Research question

The following research questions are formulated based on the objective of the study to keep the study in focus.

1. ***What is the current level of awareness of blockchain technology among IT administrative staff and educators in higher education?***
2. ***How can we take initiatives or steps to educate all stakeholders in higher education about blockchain technology?***

2.4 Scope and Limitation

The scope of this thesis is focused on exploring the current level of understanding and available options to educate oneself about blockchain technology among the stakeholders in higher education in Sweden. The study uses an early exploratory investigation into the topic. It is vital to note that the purpose of this study is not to provide a full analysis or systematic investigation into the subject matter.

3 Previous Research

The earliest implementation of blockchain technology (Chen et al., 2022) is considered to be Bitcoin and blockchain technology has been majorly adopted in the field of financial transactions where traceability is crucial. Ever since the focus of many researchers has been on the principles of the blockchain technology behind cryptocurrency and they are continuously developing applications and exploring the potential benefits of using this technology in various fields beyond financial transactions (Chen et al., 2022).

3.1 What is blockchain?

Blockchain is a set of nodes or digital blocks that contain data or information. These blocks are interconnected by storing the cryptographic hash of the previous block connecting each other forming a chain (Panagiotidis, 2022). In order to remain valid, any changes made to one block require all the members of the network to update all the following blocks (Chen et al., 2022). This is reached after the consensus about its truthfulness is reached by all the peers in the network (Delgado-Von-eitzen et al., 2021). Simply put Blockchains or distributed ledgers store and verify data and information. In this case, the ledger is public (no permission is required) so it cannot be easily modified (Panagiotidis, 2022). This ensures data and transactions are recorded and valid.

3.2 Blockchain types and stages

There are three main types of the blockchain (Panagiotidis, 2022; Delgado-Von-eitzen et al., 2021)

1. Public: There is no need for authorization to join the network. Because anyone may download the software and become a node in the network. This method is deemed inefficient and requires more resources to maintain.
2. Private: To join a private network, permission is necessary, and it is thought to be more efficient and requires less processing power or resources.
3. Consortium: It is a hybrid of public and private blockchains that requires permission to join and is governed by a group of organizations.

According to Delgado-Von-eitzen et al. (2021), blockchain technology has undergone a remarkable evolution, advancing through four transformative stages. Blockchain 1.0 marked the technology's inception, focusing primarily on cryptocurrencies and financial transactions. As the technology progressed to Blockchain 2.0, innovative features such as smart contracts, privacy enhancements, and non-native tokens emerged, expanding its potential applications. With Blockchain 3.0, the technology extended its reach to various industries like healthcare, supply chain, and education, revolutionizing traditional processes. Currently, in Blockchain 4.0, the integration of Artificial Intelligence (AI) empowers decentralized decision-making based on verifiable blockchain data, further unlocking the immense potential of this ground-breaking technology.

3.3 Factors contributing to the lack of awareness of blockchain technology

While there has been increasing body of literatures exploring the application of blockchain technology, potential benefits, and challenges of adopting blockchain technology in higher education, there has been a very limited number of educational institutions at present which has adopted the technology. One possible reason for the adoption could be due to the public's limited awareness of blockchain technology (Lam & Dongol, 2022).

Here the author tries to explore possible factors that could be contributing to the lack of awareness about blockchain technology.

1. Complexity: Blockchain technology can be difficult to understand, making it difficult for learners, educators, and other professional parties to understand blockchain technology platforms and smart contracts, making academic institutions hesitant to implement them (Daraghmi et al., 2019).

2. Lack of user-friendly interface: since a lot of time and energy is required to understand the working process of blockchain technology itself, a more user-friendly interface could help the public to understand and use it better (Lam & Dongol, 2022).
3. Lack of standardization: There are different proposed systems for the application of blockchain technology in education but a lack of standardization. The reason behind this is these proposed systems do not take into account that the different administrative processes of each institution vary and these proposed systems should be tested and evaluated as per institutional requirements and feedback from users (Chen et al., 2022).
4. Limited use cases: As mentioned earlier there are limited institutions that have adopted blockchain technology as of now which is illustrated in Table 1.
5. Regulatory and legal changes: Although blockchain provides security and privacy, it still does not completely comply with regulations such as GDPR (Delgado-Von-eitzen et al., 2021) and provide privacy at the network level (Saleh et al., 2021).

3.4 Blockchain application in higher education

As mentioned earlier, the focus on utilizing blockchain technology in higher education started in 2017. Ever since there have been several research proposals or models suggested by researchers for various needs of higher education. Features like decentralization, transparency, immutability, and traceability of blockchain provide various advantages in the field of the education sector (Mohammad & Vargas, 2022). Based on previous research on blockchain technology in higher education, few of the potential application of blockchain technology in higher education are discussed below, which has been derived from previous literature review course work of the author of this paper.

3.4.1 Certificate Management

At present the importance of utilizing blockchain technology in higher education is given to certificate management (issuance, verification, storing, and validation) (Nousias et al., 2022). Certificate management has become important due to the increased mobility of people for the sake of education and employment and it is crucial to verify the academic qualification. Meanwhile Nousias et al., (2022) discusses in detail about the problems of existing systems to validate certificates which are time-consuming, financially expensive, old-fashioned, and incompatible with modern life and believes that blockchain application could improve the process of academic certificate validation and verification.

Along with it Nousias et al., (2022) also proposes Verified Degrees (VerDe) platform, a unified verification system on the Ethereum blockchain. VerDe efficiently registers and verifies academic qualifications, addressing fraud and mobility issues. Another approach discussed by Nousias et al., (2022) is EduCTX platform a blockchain-based application on the private Ark blockchain, which registers tokens for qualification verification. In addition, Lam & Dongol, (2022) discuss three current educational projects based on blockchain that hash certificate information. Institutions continue to generate and distribute credentials using black-box procedures, claim Lam & Dongol, (2022). As a result, they suggested a platform that exposes and automates evaluation processes using smart contracts.

There are several proposals and projects which are being developed for certificate management (Delgado-Von-eitzen et al., 2021). While Delgado-Von-eitzen, Anido-Rifón & Fernández-Iglesias, (2021) expressed concerns about the issues with scalability present in current blockchain initiatives that, they also proposed an innovative model that complies with GDPR regulations that solves the issue. In order to address the scalability issue, Saleh et al., (2021) also suggests a Decentralized Certificate Verification Privacy Control Protocol for granting and confirming educational certificates while protecting privacy and confidentiality at the network level. Meanwhile, there are several articles discussing the use of blockchain technology for maintaining digital certificates. The table 1 provides a list of these articles and the institutions covered.

3.4.2 Data Management

Along with certificate management, several literatures emphasize the use of blockchain technology for Data management (secure student and teacher's records and information) with the help of Decentralized Application (DApps) which runs on a private blockchain network using Inter Planetary File System (IPFS) and Smart contracts has been discussed by Aslan & Ataşen, (2020). This proposed system Dapps is under development by TÜBİTAK BİLGEM (Aslan & Ataşen, 2020). Meanwhile, Daraghmi et al., (2019) proposed a blockchain-based design called Unichain which employs time-based smart contracts to manage Electronic Academic Records (EAR) for monitoring transactions and controlling access to EARs.

Additionally, Lam & Dongol, (2022) discuss strategies to enhance student protection through controlled educational procedures and highlight the benefits of blockchain for data integrity and storage. For which they propose the VerDe platform, which provides decentralized data storage and quick authentication of academic credentials. Lam & Dongol, (2022) also developed a blockchain-based e-learning platform that uses smart contracts to

provide flexibility and control over exams and curriculum.

Meanwhile, Chen et al., (2022) emphasis on the administrative system for managing information of international students at US universities. They analyze the viability of a blockchain-based system to improve data management while preserving student privacy and they outline current issues. As illustrated in Table 1, the study offers insights into various platforms employed by various institutions for data management.

3.4.3 Privacy and Security

Another application of blockchain technology in higher education is considered Privacy and security which is required to protect or preserve academic records from fraudulence (Saleh et al., 2021). This aspect of blockchain technology has been discussed by Delgado-Von-eitzen, Anido-Rifón & Fernández-Iglesias, (2021), Zhang et al., (2020), Aslan & Ataşen, (2020) and Saleh et al., (2021). While Delgado-Von-eitzen, Anido-Rifón & Fernández-Iglesias, (2021) discuss about how the existing blockchain initiatives does not comply with GDPR and propose a solution for that issue to avoid academic certificate fraudulence, Aslan & Ataşen, (2020) emphasize on using IPFS for secure storage of documents, diplomas, certificates, post-training exams and other related files. While Saleh et al., (2021) proposes Verification privacy control (VPC) protocol to preserve privacy at network level. Additionally, Zhang et al., (2020) discusses about how blockchain application can improve secure information storage in higher education.

3.4.4 Token transfer

Another potential application of blockchain technology explored by various authors is token transfer. In context of education sector theses tokens represent certificates, credentials, achievements or rewards (Nousias et al., 2022) for completion of particular tasks or courses, as well as digital exchanges of assets for the purchase of textbooks, related services, or regulated studies (Lizcano et al., 2020). Turkanović et al., (2018) proposes ECTX tokens for global higher education credit platform named EduCTX. Meanwhile, Lizcano et al., (2020) proposes kudos tokens for rewarding students for their competency.

Furthermore, customized ERC-20 tokens were proposed by Nousias et al., (2022) as VerDe tokens which is transferred to student's wallet for the completion of their degree. Apart from these Cryptocurrency is automatically transferred to student's account upon meeting certain requirements from University's account which is called bursary payment system introduced by Bálint et al., (2019).

Furthermore, Table 1 illustrates project which are under development in few institutes which are discussed by few authors. Overall, these articles demonstrate that blockchain technology has the potential to enhance a variety of aspects of higher education, from student privacy, payment system and data storage to administrative procedures and managing international students. The suggested platforms and layouts showcase the cutting-edge uses of blockchain in the field of education.

Application category	Publication	Educational Institutions	Areas of Blockchain use
Certificate	Delgado-von-Eitzen et al. (2021) Nousias et al. (2022) Saleh et al. (2021)	The University of Nicosia	To store and confirm diploma.
	Delgado-von-Eitzen et al. (2021) (Daraghmi et al., 2019)	MIT Media Lab	Developed the Blockcerts platform to issue academic diplomas which can be verified easily by third parties
	Nousias et al. (2022) Saleh et al. (2021) Daraghmi et al., (2019) Lizcano et al., (2020)	Massachusetts Institute of Technology (MIT)	Blockcert, to issue verifiable digital diplomas and professional certificates, doesn't utilize the blockchain in a global higher education editing and grading scale. Utilized it to protect and validate the certificates that the application issued
	Panagiotidis, P. (2022) Saleh et al. (2021)	Holberton School	The first institute to apply blockchain technology to store degree and Blockchain-based certification system to Grant blockchain technology certificates

	Saleh et al. (2021)	National University of La Plata	Blockchain-based certification system to Grant blockchain technology certificates
	Saleh et al. (2021)	Holberton School	Blockchain-based certification system to Grant blockchain technology certificates
	Nousias et al. (2022)	Fraunhofer Institute for Applied InformationTechnology (FIT)	Stores the diploma's fingerprint in the blockchain using TrueRec created by SAP to verify any digital credential, which is added to Ethereum the fingerprint of digital credential, and students must be registered in the document management system for diploma verification.
Data Management	Nousias et al. (2022) Panagiotidis, P. (2022)	Sony Global Education	A blockchain platform to store, protect, and exchange information related to student performance and progress
	Panagiotidis, P. (2022)	BitDegree	A gamified online education platform to connect students with teachers and provides users with courses and learning incentives such as tokenized scholarships

	Panagiotidis, P. (2022)	ODEM.io	A platform that offers direct connections with educators, courses, and access to professional opportunities that meet students' profiles while, using tokens, ensuring the validity of their continuing education certificates
	Lam & Dongol (2022)	Sony GED Blockchain (Hyperledger Fabric)	Developers at educational institutions can use their application programming interface (API) to securely store learning history data and certificates, integrating with third-party e-learning systems.
	Lam & Dongol (2022)	OpenLearn Blockchain from Open University (Open University, 2018). OpenLearn Blockchain (Ethereum)	An experimental plugin for Moodle, a popular course management system, has been developed. Achievement badges can be stored on the Ethereum blockchain. Students can register for courses and receive badges in a "Student Learning Passport".
Token Transfer	Fedorova & Skobleva, (2020)	University of Nicosia	has employed smart contracts and accepted cryptocurrency payment methods initially.

	Nousias et al. (2022)	EchoLinkTech	EchoLink, smart contracts, and ERC-20 tokens to store diplomas on the Interplanetary File System (IPFS)
	Nousias et al. (2022)	University of Zurich (UZHBC)	Utilized smart contracts in Ethereum and generates the fingerprint of digital degrees
	Nousias et al. (2022)	The University of Maribor, Solvenia	Proposed EduCTX to simulate the credits assigned to students once they succeed in a course.
	Lam & Dongol (2022)	MIT – Blokcerts (Bitcoin)	Education providers can store a batch of certificates by paying for a bitcoin transaction, storing data in the OP RETURN transaction field on the global bitcoin blockchain.
	Daraghmi *et al.*, (2019)	Virginia colleges	colleges has started to develop blockchain-based diplomas to distribute student degrees through the decentralized computer networks that power Bitcoin
	Daraghmi *et al.*, (2019)	the United Arab Emirates University (UAEU)	developed a large-scale project called Passport that utilizes the benefits of blockchain for improving the educational and the organizational efficiency

Table 1: Blockchain use cases by publications and universities

3.5 Awareness of blockchain technology

The previous awareness studies are related to the field of finance where the authors explore the usage of blockchain technology in Auditing and investigate the awareness level of auditors about blockchain technology applications in auditing. The previous studies reveal that blockchain technology is still in its early stage, and its benefits are still debated in society (Deepashika & Seneviratne, 2022).

It is also seen that the complexity of blockchain technology makes it difficult to understand it by individuals and it will take a long time to alter the technological sector (Deepashika & Seneviratne, 2022). Surana and Bhanawat, (2022) found that the accounting professionals are somewhat aware of blockchain technology and its application in finance sector, while they still lack familiarity with other applications of blockchain in the field. Further, the studies suggest that the lack of awareness of blockchain technology can be addressed by educating the individuals in the industry about the potential benefits (Surana & Bhanawat, 2022; Deepashika & Seneviratne, 2022) of blockchain and considering government contribution to the development of the blockchain in the commercial sector needs to be explored.

4 Theoretical frameworks

The literature on information systems (IS) and information technology (IT) offers a diverse set of ideas, models, and theoretical structures that address a wide variety of implications, including innovation. The list of theories never ends (Gupta et al., 2022). In order to understand the current level of awareness of blockchain technology among educators and IT administrative staff, it is necessary to understand their attitude, perceptions towards the technology. The individuals' attitude towards the technology determines their technology acceptance which is the first step towards technology adoption (Granić & Marangunić, 2019). In recent years majority of researchers have utilized theories like UTAUT/TAM and TF to understand the technology acceptance in educational context (Granić & Marangunić, 2019).

In this thesis the author uses UTAUT/TAM and Technological Frames (TF) theories to understand, explore and address the research questions. Dwivedi et al., (2019) has argued that the original UTAUT by Venkatesh Robert Smith et al., (2003) may not be applicable for all context and may not fully capture the factors which influence technology acceptance. Meanwhile, UTAUT Venkatesh Robert Smith et al., (2003) does not explicitly mention about

contextual factors like organizational culture. Using TF theory will complement the lack of UTAUT and provide more comprehensive understanding of blockchain technology acceptance in the context of HEIs. This thesis also uses some pointers from the diffusion of innovation theory by E.M Rogers in 1962 to understand how a new technology gets adopted. While diffusion of innovation theory provides the understanding of innovation acceptance, it is not directly utilized to analyze the results in this thesis. The primary theoretical frameworks utilized to analyzing the results in this thesis are:

1. **Unified Theory of Acceptance and Use of Technology (UTAUT):**

UTAUT model was created by Venkatesh, Morris, Davis, and Davis in 2003. UTAUT model can be used to identify the factors which influence the acceptance of blockchain technology in higher education by measuring the behavioral attitude and actual usage (Oye et al., 2014). UTAUT reduces the 32 variables identified in eight previous models such as TAM (Technology acceptance model), TAM2, Innovation of Diffusion Theory (IDT), TRA (Theory of reasoned action), Motivational model (MM), TPB (Theory of planned behavior), Combined TAM and TPB (C-TAM, C-TPB) and Model of PC Utilization (MPCU) into four main effect Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions and four moderating factors (Venkatesh Robert Smith et al., 2003) which are useful in understanding the level of awareness of blockchain technology.

One of the arguably most important contributions of TAM, which was established by Davis in 1989, is its focus on user's attitudes regarding technology use as well as the perceived usefulness and simplicity of use of the technology (Gupta et al., 2022). These elements are incorporated into the UTAUT model, providing for a better understanding of user's willingness to notice and accept blockchain technology among IT administrative staff and educators in higher education, which will provide the insight of their level of awareness of blockchain technology. The degree to which a person believes that using a system will help them execute their work better is referred to as perceived usefulness. The degree to which a person believes that using a system is simple is referred to as perceived ease of use (Gupta et al., 2022).

2. **Technological Frames (TF**):

The concept of TF developed by Orlikowski and Gash offers valuable insights about the members of particular community's technological frames which influence their actions toward technology use and change. The theory provides insights on individuals'

assumptions, expectations, and knowledge about technology which significantly influence their actions and choices regarding the design and use of technologies in a particular community (Orlikowski & Gash, 1994).

In the context of this thesis study, Technological frames is used to understand IT administrative staff and educator's current level of awareness about blockchain technology in higher education. It explores their understanding and knowledge about the purpose, context, importance, and role of a blockchain technology which influence their action and choices regarding the design and use of technology (Orlikowski & Gash, 1994).

Furthermore, Orlikowski and Gash suggests that it is necessary to identify the inconsistencies and incongruences while introducing new technology within an organization. This becomes crucial in reducing the likelihood of unintended misunderstandings and delusions around the adoption and use of blockchain technology in higher education. By addressing these inconsistencies and incongruence, organizations can overcome potential challenges and ensure a smoother transition and adoption of the technology. Therefore, by utilizing TF, the thesis study aims to understand how IT administrative staffs and educators in higher education understand and conceptualize blockchain technology (Orlikowski & Gash, 1994) that may help in its effective adoption and usage.

This thesis study aims to investigate the current level of awareness of blockchain technology among IT administrative staff and educators in higher education by applying the UTAUT/TAM (Venkatesh Robert Smith et al., 2003) as a factor theory and the TF (Orlikowski & Gash, 1993) as a process theory. By utilizing these theories in this thesis, it is possible to investigate individual perceptions, attitudes, and the diffusion of blockchain within the higher education context. Furthermore, it will investigate the numerous aspects that influence blockchain technology awareness and acceptance among IT administrative staff and educators. A thorough understanding of the level of knowledge and readiness for blockchain technology in higher education can be acquired by integrating these process and factor views.

5 Methodology

The methodology used to collect data and how the data has been managed and analysed is explained in this section. The ethical considerations which have been considered during the study also highlighted.

5.1 Research Method

This study used a two-step research process that included a comprehensive review of the literature followed by a qualitative approach utilizing semi-structured interviews. The literature review served as a basic step in understanding the present level of blockchain technology research in higher education, as well as existing studies on blockchain technology awareness. A rigorous evaluation of related scholarly articles, research papers, conference proceedings, and other trustworthy sources was conducted for the literature review. It sought to discover and critically assess existing literature on blockchain technology in higher education, with a particular emphasis on the level of understanding among IT administrative staffs and educators. While the assessment identified a vast body of literature on the application of blockchain technology in higher education, there was a significant gap in research on awareness level.

Based on the findings of the literature research, a qualitative approach using semi-structured interviews was chosen to investigate and get an in-depth understanding of the level of awareness of blockchain technology among IT administrative staff and educators in higher education. Since blockchain technology is still in its initial stage of adoption in higher education, it is important to understand the individual perspective of end-users. With qualitative approach, it was possible to explore the technology from every perspective and at all levels of understanding. The second research question, "*how can we take initiatives or steps to educate all stakeholders in higher education about blockchain technology?"* was answered by the author by using a qualitative approach. The qualitative approach offered insights into the causes of the lack of awareness, the potential benefits of blockchain technology for higher education institutions, and future improvement strategies. In contrast to quantitative methods, which would have provided numerical distinctions between aware and unaware individuals.

The purpose of the interview is to determine the extent of individual awareness about blockchain technology in higher education and the steps to educate them. The majority of current studies focus on blockchain-based application model proposals and the benefits and barriers of implementing them in higher education. The study focuses on IT administrative staff

and educators of Swedish universities. Through interviews with them, the study has gathered their personal experience with blockchain technology and insight into how it is seen.

5.2 Literature selection

This section provides insights about the literature selection process used to identify the relevant literatures in the field of blockchain technology. Prior to semi-structured interviews literature review was conducted to gather relevant research articles and studies that focus on application of blockchain technology in the context of higher education and awareness related studies (this section has been derived from the previous literature review course paper of the author of this paper).

5.2.1 Search terms

Based on the research question the search terms used for the identification of relevant literature for the study are:

1. (Blockchain OR Decentralized) AND (Application) AND (Academia OR Education OR "higher education").
2. (Blockchain OR Decentralized) AND (Awareness) AND (Academia OR Education OR "higher education").

5.2.2 Databases

The database was chosen based on the research question and the topic's relevancy. Academic Search Premier, IEEE, Emerald, Eric, Scopus, ACM digital library, and Web of Science are some of the databases available. Aside from searching databases, a few relevant articles were discovered through backward searches and new publications that cited them.

5.2.3 Review process

The results of searching in the databases Academic Search Premier (18), IEEE (34), Emerald (88), Eric (6), Scopus (55), Web of Science (4), and ACM Digital Library (8) after applying every limitation and analyzing the keywords related to the research. Following that, a total of 213 articles were discovered that were nearly related to the Blockchain; 20 duplicate articles were removed, and 99 articles were excluded based on the title of the article, which was irrelevant to blockchain technology in context of higher education and awareness studies.

As a consequence, 94 articles were assessed, with 58 articles being rejected based on title and abstract. 36 papers were reviewed for eligibility, 11 of which were chosen for investigation, and one more item was included for analysis using a backward search.

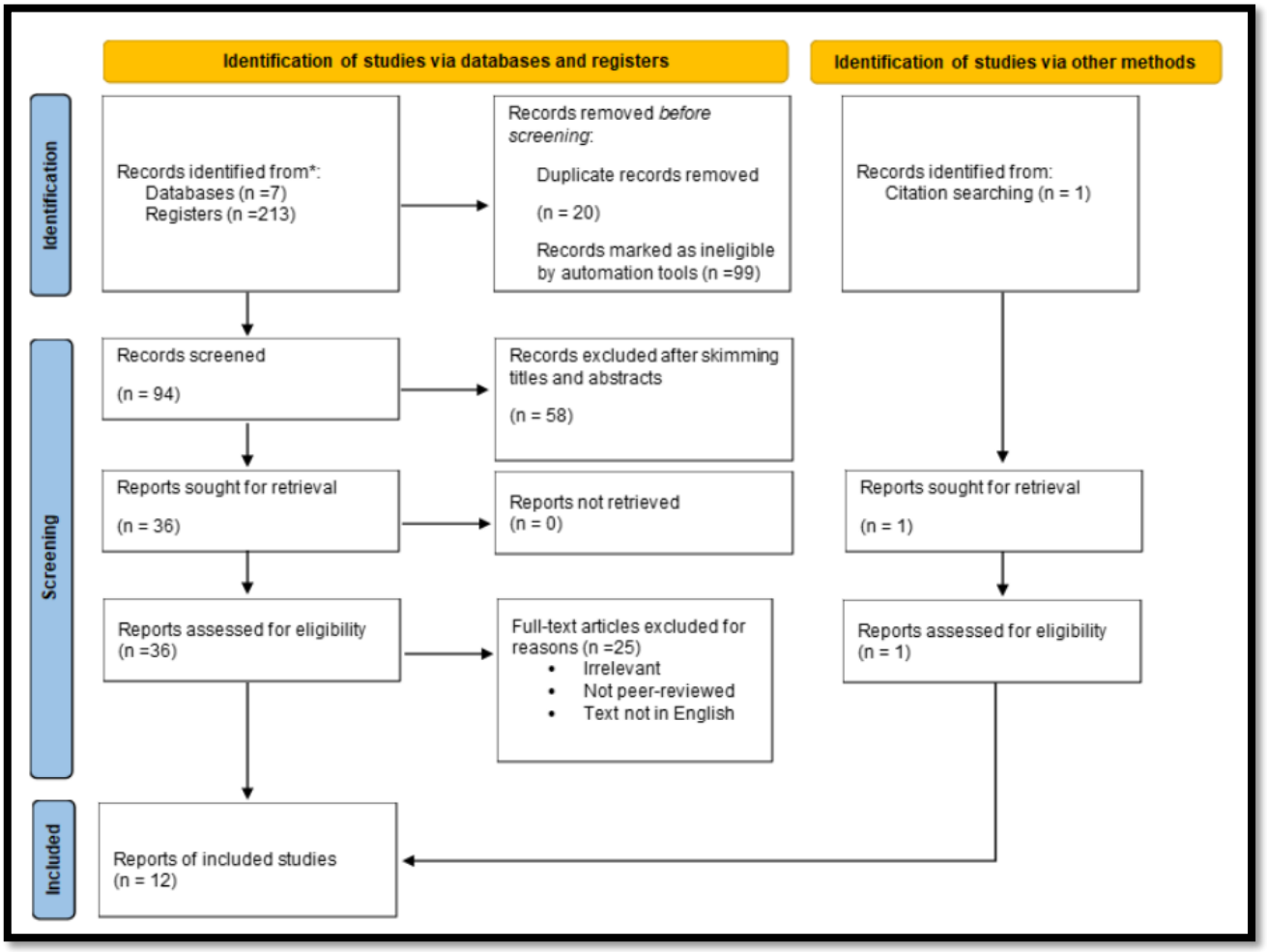

Figure 1: PRISMA diagram showing the screening process of the database search results

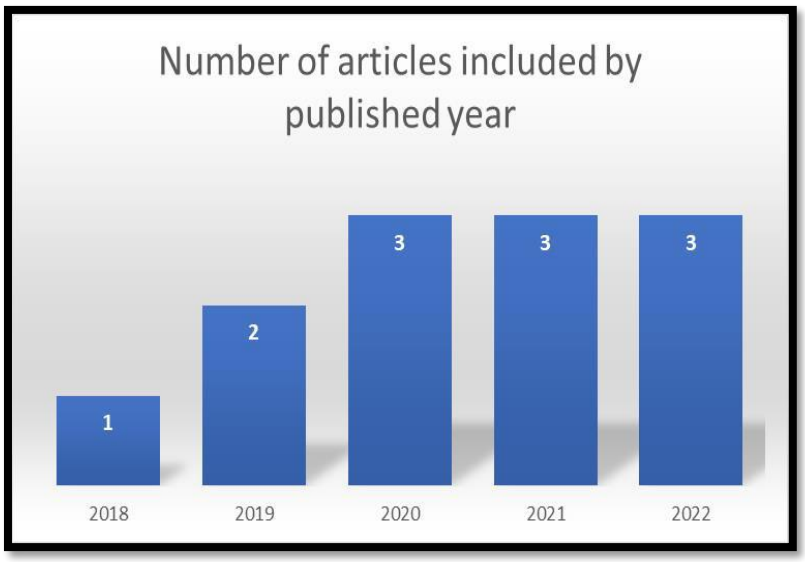

Figure 2: Number of articles included by the published year

5.2.4 Eligibility Requirements

The resulting papers, as shown in the Prisma diagram database search for a review, were filtered based on the following criteria:

1. The articles are written in English.
2. The articles should be available in full text online.
3. The articles should be peer-reviewed.
4. The articles must be focused on the usage of blockchain in education.
5. The articles must be largely about blockchain in HEIs. The papers should not only convey the author's or writers' opinions but also provide some application cases.
6. In the sector of higher education, blockchain technology is regarded as new and has begun to gain attention since 2017, where it has increased gradually in importance and appears likely to develop in the coming years (Mohammad & Vargas, 2017). This is why the search was limited to 2017-2023.

5.2.5 Information extraction

The identified relevant articles from the literature selection process were thematically analyzed using NVivo 1.7.1 tool to analyze the gathered data to identify designs, proposed models, various application of blockchain technology in higher education and the current level of awareness of blockchain technology. The findings from this analysis have been summarized in previous research section of this paper.

5.3 Data Collection and Analysis

The primary data collection was done by conducting semi-structured interviews, which were conducted from mid of April to the first week of May with the selected Respondents who are working in Swedish Universities. The interview guide was created based on the theories mentioned in the theoretical framework section. The interviewees were given the opportunity to respond to the open-end questions and follow-up questions were asked when deemed necessary.

The interviews conducted for this study were both using online communication platforms like Zoom and Teams as well as in person; based on the interviewee's preference, available time and geographical location. The interviews which were conducted via Zoom and Teams, were recorded and transcribed with the inbuilt function available in the applications.

The recording of the interview was done with the interviewees' consent. The interview conducted in person was audio recorded with interviewees' consent and transcribed using the online tool "Otter.AI". The interviews were 25-45 minutes duration. All the interviews were conducted in English. Table 2 illustrates the duration of each interview conducted for this study.

Interview	Duration
Interview 1	40 minutes
Interview 2	25 minutes 36 seconds
Interview 3	35 minutes 31 seconds
Interview 4	35 minutes 41 seconds
Interview 5	45 minutes 20 seconds
Interview 6	30 minutes
Interview 7	40 minutes 15 seconds
Interview 8	30 minutes
Interview 9	30 minutes
Interview 10	30 minutes

Table 2: Duration of each interview

5.3.1 Semi-structured interviews

The semi-structured interview questions were prepared based on known theories related to technology adoption which were asked of all the interviewees to ensure consistency and to minimize variations of data collection process. Along with the standardized semi-structured interview questions follow-up questions were asked when necessary. An interview guide was prepared with 10 open and prepared questions for all respondents (Bryman Alan, 2012) which can be seen in Appendix section of this thesis. The interview guide was carefully designed to maintain a balance between structure and flexibility, allowing the interviewer to dig deeply into the research topic while being open to unexpected insights and chances for inquiry.

It is vital to note that the very first set of questions was standardized, and the following questions during the interview varied based on the responses of the interviewees. This method allows for a more personalized and individualized investigation of their blockchain technology experiences and awareness. The interview technique facilitated an in-depth understanding of individual perspectives while still keeping a structured framework by tailoring the follow-up questions to their specific responses.

Choosing a semi-structured interview was based on its flexibility in conducting the

study and developing deeper insights into the respondent's perspective of the topic or subject (Myers & Newman, 2007). During the interview, it is the researcher's responsibility to be attentive and to ask follow-up questions when required to get deeper insight from the interviewee in relation to the research question (Bryman Alan, 2012). Furthermore, the Respondent selection was done carefully to be able to answer the research question for which the snowball sampling method has been used. The snowball method is a quick and inexpensive way to find people that would otherwise be difficult to find. It takes less time and allows the researcher to communicate more effectively with the samples and also highly used in research studies like educational field (Naderifar et al., 2017).

5.3.2 Respondents Selection

The Respondents were chosen in a strategic way defining the criteria to be able to answer the research question. The sampling involved experts in the field of blockchain technology, educators and IT chiefs or managers of Swedish Universities. Since the interview aimed to get individual perspectives on the level of awareness of blockchain technology, different levels of experts in the field of higher education were involved in the study. The potential respondents were approached via an email by providing them details about the study, its intention and requesting their participation in the study. However, it was found that the subset of these potential respondents expressed a lack of familiarity with blockchain technology and declined the request. An example of one such email response is provided below:

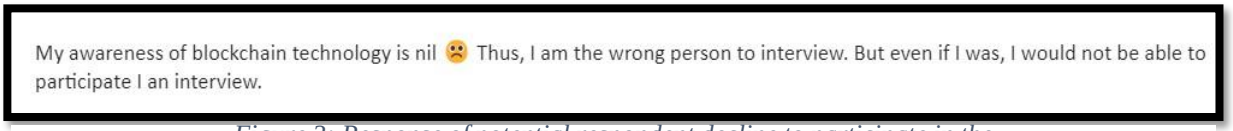

Figure 3: Response of potential respondent decline to participate in the study

These responses highlight the limited awareness and knowledge of blockchain technology among certain individuals in the targeted population. While these potential respondents were not included in the study, their responses further emphasize the need to investigate the current level of awareness and understanding of blockchain technology in higher education.

Due to responses like mentioned above a snowball selection method is utilized in identifying potential respondents since blockchain technology is relatively new in the field of higher education. Snowball method taps into the existing network of respondents who are familiar with blockchain technology and introduced to other respondents in the network (Naderifar et al., 2017). This was effective to reach out to potential respondents with the help of reference by other respondents which helped to increase the level of trust and connection,

which helped for more open and candid discussions during the interviews. This resulted in extensive and thorough data saturation from respondents' level of awareness, experiences, and perspective of blockchain technology in higher education. Table 3 illustrates the Respondent list involved in the study and their designation at various Swedish Universities, also their expertise and experience with blockchain.

Respondents	Designation
Respondent 1	Professor, Blockchain Technology Expert
Respondent 2	Professor, Worked on Blockchain-based application
Respondent 3	Professor worked on blockchain-based application
Respondent 4	Ph.D. student and Blockchain Technology researcher
Respondent 5	Professor, Computer technology scientist
Respondent 6	IT Manager
Respondent 7	Professor, Blockchain Technology Expert
Respondent 8	IT chief
Respondent 9	IT Staff
Respondent 10	Professor, Working closely with Ladok

Table 3: Respondents list

5.3.3 Data Analysis

Prior to analyzing the data, thorough measures were taken to make sure the validity and accuracy of the primary data. This involved reading and cross-checking with the original recordings to make sure the transcripts represent accurately to the respondents' responses. This helped to minimize the potential errors or misinterpretations by providing data integrity. Once the transcripts were prepared thematic analysis was utilized to analyze the data. Thematic

analysis is flexible and useful to identify various aspects of awareness level of blockchain technology in higher education (Braun & Clarke, 2006). This method was useful to identify relevant patterns or themes by exploring the data.

Additionally, this study uses established theoretical frameworks as previously discussed to analyze the data by identifying key themes which represents the research question closely. The following steps were undertaken for analyzing the data as per Bryman's guide (2012).

1. The transcripts were read without interpreting them to gain a common understanding of respondents' perspective. This was done to become familiar with the data and to identify important statements (Bryman, 2012).
2. The coding was conducted after identifying the important, interesting, and relative statements within the transcripts. These coding were descriptive about the statements identified in the transcripts. These statements included a range of topics such as definition of blockchain, explaining how it works, describing effective ways to communicate its concepts to individuals unfamiliar with the technology, investigating misconceptions, assessing respondents' level of awareness and understanding, investigating potential use cases, and investigating factors contributing to the lag in adopting blockchain technology.

   The relevant statements were coded by grouping them according to their content and relevance and alignment to the research question of this thesis. This coding procedure organized and classified the data, making it more manageable and aiding the identification of major themes and trends.
3. Once the coding of relevant statements was completed, themes were identified based on the occurrence of interesting topics (Bryman, 2012). The themes identification involved looking for commonalities, recurring patterns within the coded data. The codes were gathered together which represent the overall concept that highlight respondents' perspectives on the awareness level of blockchain technology in higher education (Bryman, 2012).

For the purpose of data analysis NVivo application was used. The use of NVivo allowed for a thorough examination of the interview data, ensuring that no critical information or significant insights were omitted. The software aided in the efficient organization, maintenance, and retrieval of coded data, allowing for the identification of recurring themes and patterns throughout the dataset. The identified themes are discussed in detail in the results

section of this paper. The codes and Themes identified during this process are illustrated in Figure 4.

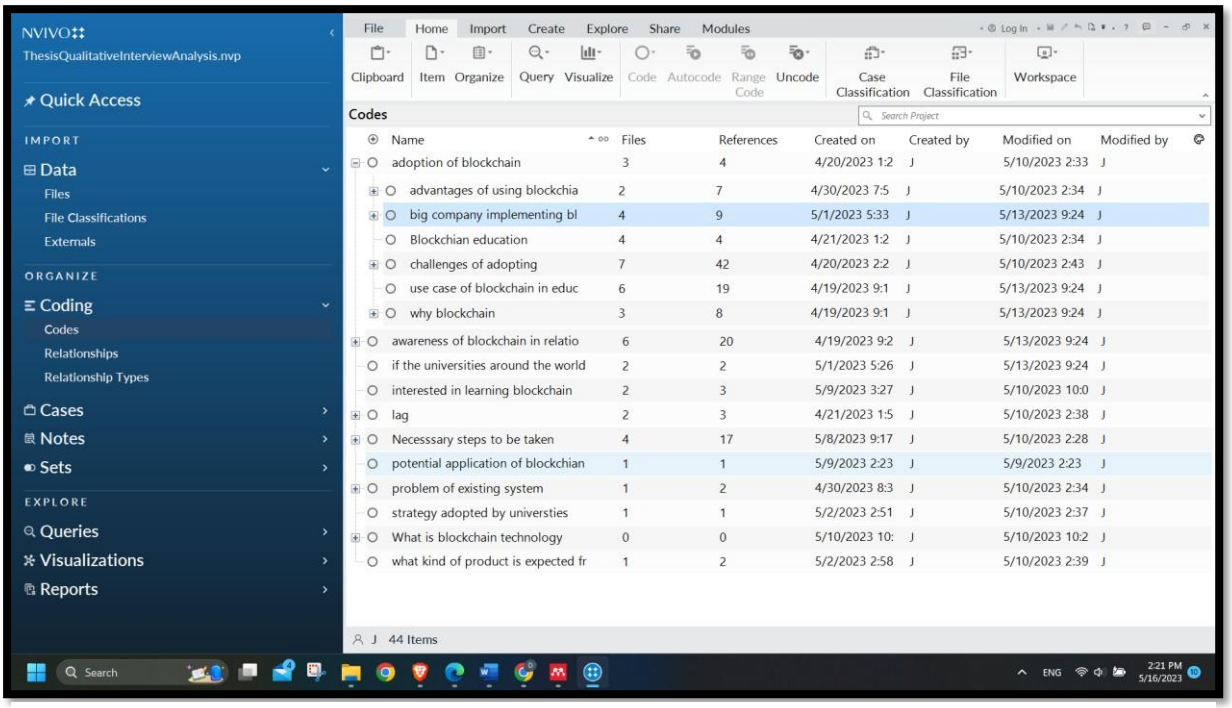

Figure 4: Codes and Themes identified during data analysis

5.3.4 Ethical Consideration

Ethical consideration is important during the research studies to safeguard the integrity and respect of respondents involved in the study (Bryman, 2012). This thesis study was conducted aiming at the highest ethical standards. The following steps were involved during the study.

1. Informed consent: The potential respondents were sent an email informing about the research study in detail and gained their consent to participate in the study via email. They were also informed about the duration of the interview and given the choice to leave the study at any time. The informed consent mail is illustrated in Appendix section of this paper.
2. Confidentiality and anonymity: Throughout the study it is made sure that the confidentiality of the respondents is maintained. Any detail which could potentially lead to the respondents' identification is not disclosed in this study.
3. Data protection: The data gathered during the study has been handled with care and securely stored.
4. Harm to participant: During the study no harm has been made to the participants. The interview guide was set in such a way that it does not contain any questions which could

cause pain or discomfort to the participant. The research environment was set based on the participants' preference and comfort.

Overall, the ethical considerations undertaken in this study were to protect the participant's rights, privacy and well-being. By following ethical principles, this study attempts to maintain the highest level of research quality and the reliability of the findings.

5.3.5 Validity and Reliability

The validity of this thesis is focused on accurately investigating the level of blockchain awareness among IT staff and educators in higher education (Fitzner, 2007). The interview questions were carefully crafted to ensure validity, based on a thorough literature review carried out prior to the qualitative method along with established theoretical frameworks discussed in this thesis. The questions covered a wide range of issues, with the goal of understanding respondents' perspectives, knowledge, and ideas for increasing blockchain awareness in higher education. Questions were developed particularly for participants with varied levels of blockchain knowledge, with the goal of delving deeper into their understanding and perspectives.

Reliability refers to the consistency and stability of the thesis findings (Fitzner, 2007). A semi-structured interview guide was utilized to avoid bias and ensure uniformity between interviews to improve reliability. The first question in the appendix part of this paper serves as a jumping-off point for the following follow-up questions. It is crucial to note, however, that all of the questions from the interview guide were asked of each participant, ensuring thorough data collection, the questions were designed to elicit insights from persons with varying levels of blockchain understanding.

6 Results and Findings

To address the research questions of this thesis*: What is the current level of awareness of blockchain technology among IT administrative staff and educators in higher education?* and *How can we take initiatives or steps to educate all stakeholders in higher education about blockchain technology?* a qualitative semi-structured interview was conducted with 10 respondents working in the field of higher education. Six themes were identified during the data analysis stage and each theme will be theoretically discussed using the lenses of UTAUT and TF in this section.

1. Understanding of blockchain technology.
2. Potential application of blockchain technology in higher education.
3. Potential challenges of implementing blockchain technology in higher education.
4. Awareness of blockchain technology in higher education.
5. Third-party involvement in developing blockchain-based applications for higher education.
6. Essential steps to increase the awareness level of blockchain technology in higher education.

The participants involved in the study are anonymous so they will be represented as respondent 1, respondent 2, and respondent 3 so on.

6.1 Understanding of blockchain technology

This theme provides a summary of respondents' knowledge of blockchain technology. The first question asked of the respondents was to determine their level of interest in blockchain technology and how they interpret it based on what they understood (see Appendix 1 for interview questions).

6.1.1 Respondents' introduction to blockchain

This section provides insights into how respondents came across blockchain technology, what caught their attention or interest, and what were they looking for when they came about blockchain. Most of the respondent's initial knowledge of blockchain technology is through Bitcoin which they started exploring to understand the technology in detail for research purposes or understand how it could benefit their job. Respondent 1, Respondent 2, and Respondent 6 explain it as,

"2015 or so, when I had moved to Sweden, we were kind of looking for new research areas. And at that point, I kind of returned towards blockchain because it was kind of locked in that media and World Economic Forum" **(Respondent 1)**

"I bought some Bitcoin a bit later than that and followed, followed basically the different sort of iterations of blockchain I guess since then. So I've been following it maybe like 10 years plus reasonably closely, but only in the last like couple of maybe three years Have I started focusing on it." **(Respondent 2)**

"in the industry that are on executive level, I mean, we, we all started to try and understand that technology and see how it could affect us or how we could benefit from it. And I did, I did my homework back then as well." **(Respondent 6)**

From the above three responses, it can be observed that the distinct pattern of the respondent's engagement with blockchain technology. Respondent 1 follows blockchain primarily out of academic interest, as they were looking of new research areas and blockchain was prominent topic in the media and the World Economic Forum. This suggests a motivation driven by intellectual curiosity and exploration within academic context. while Respondent 2 followed blockchain's growth and more of personal interest and started thinking about blockchain in the contexts of academic only recently, showing a shift in their perception and assessment of blockchain's significance beyond personal interest.

Meanwhile, Respondent 6 who is on executive level, has looked into the technology in terms of professional interest trying to understand its impact and benefits within their sector. Their response implies that they are taking a proactive approach to learning about new technology as part of their professional obligations. This is consistent with their claim of doing "homework" to become acquainted with blockchain, indicating a concerted attempt to gain information and understanding for professional goals.

Although it is clear that bitcoin started it all, it is also clear that all the respondents who are working closely with blockchain are doing it because they put in a lot of personal time and effort into learning about it. Whereas the respondents who are less aware of the technology have had this difficulty because there is not enough reliable source of information that is easily understandable.

The initial contact and follow-through clearly align with UTAUT theory, where personal interest and follow up which are important factors in technology acceptance. While

the later parts of trying to apply blockchain in academics and educational context shows the change in perception which can be understood in the TF context where respondents try to understand the technology and how it could benefit the community, indicates a broader perspective beyond personal interest.

6.1.2 What is blockchain?

Is blockchain bitcoin? Or is Bitcoin blockchain? From the discussion above it is clear that most of the respondents start their blockchain journey with bitcoin. Here the author of this paper tries to explore what they believe blockchain is. Even though the understanding of blockchain technology among respondents is at different levels all agree upon blockchain technology being a distributed ledger and using a consensus mechanism. Respondent 8 had tried to understand the basic of it showing general interest on the technology. However, they admit that they have not been following blockchain very closely but explains it as a way to securely storing data.

"It's a way of storing data in in the way that you can it in a way that you can track securely and you can, you know, trust that that you have, they have a history log built into the blockchain. That's kind of the purpose of it to to have a immutable storage of data. But as a storage method, it's kind of ineffective as well. I mean, if you just want to store data." **(Respondent 8)**

While Respondent 5 takes a broader perspective on blockchain, explaining that it can be interpreted and utilized in various ways, while explaining the basic essence of blockchain technology and highlighting the importance of digital scarcity as a fundamental aspect of blockchain technology.

"The blockchain is what you make it to be. So it can be just about anything." **(Respondent 5)**

Respondent 5 adopts a broader view of blockchain, arguing that it can be interpreted and used in a variety of ways. They define blockchain as a distributed ledger with a consensus system that is used to keep track of something that is both digital and scarce. They emphasize the significance of digital scarcity as a basic feature of blockchain technology. They also distinguish blockchain from other distributed ledgers that lack a consensus process and underline that the primary role of blockchain is to solve the double spend problem.

"Any distributed ledger that has a consensus protocol is really just a way of keeping track of something that is both digital and scarce. So it's digital scarcity." **(Respondent 5)**

Meanwhile, Respondent 4 sees it as an idea to build a database and emphasizes looking at blockchain as an idea so the users can understand it better.

"blockchain is a is it basically is an idea a way of building a database basically. An idea which helps to develop more secure, transparent and easy to use databases." **(Respondent 4)**

These above responses show the behavioral intention of the respondents towards blockchain technology, while analyzing their views through the lens of UTAUT theory. It is clear that different respondents have distinct perspectives on blockchain technology and even though respondent 8 identified the technology but has no intention to using or adopting it in their current work since they don't see the perceived usefulness of blockchain technology. Meanwhile, Respondent 4 highlights the benefits of blockchain in terms of perceived usefulness. Overall, these responses demonstrate diverse perspectives and highlight variations in perceived usefulness and performance expectations.

6.1.3 Respondents who have used blockchain-based application

The author of this paper was fortunate to find some blockchain experts to participate in this study. These experts have used blockchain in some applications or at least tried and worked with it. This section talks about how it is being used by the respondents.

While the understanding level of respondents varies few respondents have used blockchain-based applications. Respondent 1 explains like this,

"The applications or cybersecurity audits related tools. I've used a number of kinds of different kinds of, you know, prototypes for I don't know tracking, vouchers, tracking, conference participation, tracking, conference, registration, tracking payments, different types of pilots." **(Respondent 1)**

While Respondent 5 mentioned how the usage of blockchain-based applications has helped them to understand the technology better but has never come across any blockchain-based application in higher education only reading academic articles that propose solutions or models for it.

"I have various I had used by chance. So I've not part of my work as such. But so in order to understand what it is, I need to try it out myself." **(Respondent 5)**

While respondents 1 and 5 have experienced several applications of blockchain technology in general, respondent 8 acknowledged that no specific blockchain applications

caught their attention or matched their needs in the field of higher education. The data gathered shows that there is potential lack of awareness or exposure to real use cases and practical implementations of blockchain technology in the area.

"I haven't really really for us seen any specific applications that we have been interested in." **(Respondent 8)**

6.2 Potential application of blockchain technology in higher education.

Here we try to narrow the focus of blockchain use to higher education and get respondent perspective on it. Since all the respondents are connected to higher education, it is possible to get a thorough understanding of the respondent's perspective. The theme provides the respondent's perspective on the potential application of blockchain technology which could be beneficial in higher education. The majority of the respondents agree with the benefit of using blockchain for certificate management to verify and validate certificates or diplomas and emphasize the level of transparency it could provide.

6.2.1 Certificate verification and token transfer

During the literature review, it was found that the majority of authors have emphasized the importance of using blockchain-based applications for certificate management since the movement of people around the world has increased. Which requires a system to verify their competencies efficiently. The results found in the study support the importance of blockchain-based applications for certificate management.

However, Respondent 1 discusses certificate management as well as token transfer areas which could benefit from blockchain technology by providing a secure and transparent system. Respondent 1 highlights that the current method of issuing the certificate as a PDF by Swedish secretary is not secure. They emphasize that blockchain technology could provide a more transparent system for tracking the origin of PDFs.

"So a blockchain solution could kind of have a system which is at least a little more transparent on where the PDFs might be coming from." **(Respondent 1)**

Additionally, respondent 1 also emphasize on tracking various activities in university including payments, official processes, and different types of course deliverables. In the context of educational credentials, they highlight the use of micro-credentials which would allow issuing specific parts of a course or third-party courses. This approach could reduce the hassle for students and present specific use cases for these credentials.

"other ways to use it to track tokens or track." **(Respondent 1)**

"One thing is specifically related to educational credentials is the micro-credentials. And there might be some specific use cases for those particular credentials." **(Respondent 1)**

"The obvious use case for blockchain in higher education is for certificate and reference"

(Respondent 5)

Using UTAUT/TAM and TF theories to analyze these responses, It can be seen that both respondents recognize the potential usefulness and benefits of blockchain technology in higher education. They recognize the significance of blockchain in addressing document security, process tracking, and certification management challenges. These views are consistent with the UTAUT construct of perceived usefulness, demonstrating that respondents see blockchain as a technology that may deliver tangible benefits while also improving existing procedures in higher education.

6.2.2 Credentials validation

While certificate management is an obvious use case as Respondent 5 has mentioned, meanwhile, Respondent 4 explains the blockchain-based project called One Block for Educational Credentials (OBEC) on which they have worked on. The OBEC project which is a European initiative that explores the potential of blockchain technology to identify the skills and competencies of individuals to issue learning credentials for both formal and informal learning through digital badges.

"The OBEC project, which was a European project, and to do Erasmus plus section. focused on using blockchain technology to recognize the competencies of individuals through digital badges use it to certify skills and competencies that individuals develop during their education." **(Respondent 4)**

Apart from OBEC Respondent 4 also works on blockchain-based infrastructure building digital badges at the University of Urbino in collaboration with technological partner Seneca. These badges are based on blockchain and general ledger technologies. The purpose is to certify transferable or soft skills acquired by students in courses that are not yet institutionalized. This includes immigrants, foreign students, and individuals with alternative educational backgrounds. The objective is to evaluate and certify competencies for these individuals. They also highlight the affordability and controlled nature of the blockchain infrastructure being developed. It is not open to the general public but intended for certifying

skills and competencies developed by individuals during their education. The efforts align with the goals of the European Union and the OBEC project.

"Our idea of trying to develop a blockchain infrastructure which is. Ah, affordable. Which is slightly controlled, so it's not like given just to the open public to maintain. the main point is to use it to certify Skills and competencies that individual individuals developed during their education." **(Respondent 4)**

Meanwhile, Respondent 6 provides another potential application of blockchain in higher education for credential validation.

"There's a certain I think if we use that technology, then we probably could, in a sense that we could deliver the different kinds of credentials in public and public solutions so that anyone that was interested to validate someone's credential could do that in some way without us being involved." **(Respondent 6)**

Based on UTAUT it can be clearly see that these responses highlight the perceived usefulness of blockchain technology in higher education. These responses indicate that the respondents recognize blockchain as a valuable tool for improving the recognition and validation of skills and credentials in higher education.

6.2.3 Data Security

Apart from above mentioned potential benefits of utilizing blockchain technology in higher education by respondents, another interesting potential benefit has been highlighted by Respondent 10. According to them blockchain can also be used for test environment where the students' identity is masked but the evaluation will be transparent which will make sure the student gets the credit for their work without revealing student's identity which is also been supported by Respondent 7.

"part of tests test environment if you as a student are given a task to perform and and it's supposed to be anonymous." **(Respondent 10)**

It could potentially provide a secure and decentralized platform for conducting anonymous assessments using blockchain technology, which is known for its transparency and immutability. As their identities would be masked, students would be able to participate in the evaluation process without bias or previous assumptions from the examiner.

The specifics and implementation of this notion would require further investigation, but the response suggests using blockchain technology to improve anonymity in testing or evaluation settings. This response aligns with UTAUT/TAM in terms of perceived usefulness

for using blockchain technology for test environments by students which could provide anonymity and transparency.

6.3 Potential challenges of adopting and implementing blockchain technology in higher education.

This theme summarizes the potential challenges from the perspective of respondents for adopting and implementing blockchain technology in higher education. These findings are based on the respondents' personal experience and level of understanding of blockchain technology.

6.3.1 Maturity level of blockchain in higher education

This section provides insight into respondents' perspectives of how blockchain technology is seen in higher education irrespective of what their level of understanding is. Most of the respondents have emphasized on the blockchain is not mature enough today to make it easy to adopt and implement in higher education. The reason for this it is still in its initial stage or being explored as a research topic.

"We have looked at things as a kind of research topic, but we ended up not putting them into use" **(Respondent 1)**

"We need it is a new technology. It is not a mature and stable technology. So This is why we need to more and more effort." **(Respondent 7)**

While Respondent 1 explains that since the technology is seen as not mature by the IT administrative staff who wants to keep the University's IT architecture stable it has become difficult to move forward even though there are many research-related projects and solutions available to implement blockchain in higher education without the support. Implementing new systems without the support or involvement of the IT faculty can be difficult, and often there is outright hostility or resistance towards such initiatives.

"our own IT departments, which says themselves cost center so they do not want to take anything that's not 100% mature into us." **(Respondent 1)**

Analyzing the responses through the lens of UTAUT theory reveals that blockchain technology's perceived maturity level has a key impact on its acceptability and application in higher education. Respondents' perspectives align with the construct of perceived maturity, as they believe blockchain is in its early stages of development and lacks the stability required for widespread adoption. These opinions add to the challenge and barriers that higher education

institutions confront when implementing blockchain technology.

6.3.2 Cost of implementing blockchain in higher education

Several respondents cited cost as one of the main concerns of many when it comes to new technology adoption or implementation in a field. The cost here represents learning new technology, implementing the infrastructure, maintaining it, time taken to learn and to build the application, and labor-intensive for implementing the application which will be very expensive to handle for a single University is a concern expressed by Respondent 6.

"I think it's too costly. For one university to do something like that alone." **(Respondent 6)**

Whereas, Respondent 9 was not just worried about the cost of learning new technology since they are a small team developing and maintaining various applications of the university but also emphasize the amount of time required to learn and implement new things when their glass is already full.

"It's a huge cost to learn new things." **(Respondent 9)**

"Cost of technology is a big barrier." **(Respondent 3)**

Respondent 3 agrees with Respondent 6 and 9 in terms of cost being a huge challenge in implementing blockchain in higher education. Additionally, Respondent 9 is concerned about the time is a limiting factor when it comes to implementing new technology, including blockchain. They explain that while the technology itself may not be difficult to use, the constraint lies in having enough time to dedicate to upgrading and staying up-to-date with the latest advancements.

"I guess it's the time that is the limit." **(Respondent 9)**

The responses which express concern related maintaining of the system one implemented and the time taken to learn new things align with 'Facilitating conditions construct' of UTAUT, which is drawn upon perceived behaviour control construct, which refers to the degree to which individuals believe they have the necessary resources and support to use a technology effectively.

6.3.3 Infrastructure complexity of blockchain

Respondent 5 highlights the complexity of blockchain as a factor affecting the cost of

building blockchain infrastructure. It also makes it difficult for any one party to build and maintain. This is supported by other respondents. The complexity of blockchain is another factor that affects the cost of building or implementing the application in higher education like mentioned earlier cost here represents the time taken to learn the complex technology which is supported by Respondent 5 who emphasized the complexity of blockchain which could be difficult for one party to develop.

"A blockchain infrastructure is a lot more difficult. Because not only there is not, it's not enough to have a one-party who just want to make a multi-sided market to connect people across the sides, this there has to be a discussion amongst many parties, for them to have to agree on something." **(Respondent 5)**

This response aligns with the 'Effort expectancy' construct of UTAUT which refers to the perceived ease of use and complexity of a technology. The response highlights the effort and difficulty related to building a blockchain infrastructure.

6.4 Awareness of blockchain technology in higher education.

This theme summarizes the awareness level of blockchain in higher education and highlights the misunderstanding related to the technology as well. Blockchain technology is still in the research stage in higher education, which is simply one obstacle, in addition, there are misunderstandings or misconceptions about the technology itself because it is associated with Bitcoin.

"I hardly know what blockchain is. One example is Bitcoin, but I didn't quite get the hang of it." **(Respondent 10)**

While respondent 3 explains that the awareness level of blockchain in higher education is low and its potential applications are beyond education system. Which is why awareness building-initiatives are necessary.

"Yeah. So, you know, I think a good use of blockchain technology would be to to include that in different in more awareness building initiatives" **(Respondent 3)**

Furthermore, Respondent 7 emphasizes that a lack of awareness leads to a lack of understanding which will affect decision-making about the adoption and implementation of blockchain technology in higher education.

"If there is no awareness, there is no understanding. If there is no understand, there is no decision." **(Respondent 7)**

6.4.1 Credibility and awareness

Misunderstanding and suspicion of blockchain technology among the people since it is always associated with Bitcoin and other cryptocurrencies which do not have a good reputation has led to a lack of credibility for the technology itself which is a huge barrier that Respondent 3 and Respondent 4 clearly points out.

"We found out later people are very suspicious about a technology because especially here in Sweden and they simulated a lot with Bitcoin and it doesn't have a good reputation because it's not stable." **(Respondent 3)**

"this connection with cryptocurrency, there's a huge doubt from the public those kind of technologies, because they think they're risky. They're shady technologies. They're tied to those kind of currencies, which are not controlled by the government's. myth about like criminals using them to not be traced by like financial institutions this tie to cryptocurrency makes it really hard to convince," **(Respondent 4)**

These responses align with the 'Social Influence' construct of UTAUT. Since blockchain technology acceptance is highly influenced by the reputation of Cryptocurrencies. These responses highlight that these misconception about blockchain technology creates a barrier to identify its potential benefits and uses independent of its association with cryptocurrencies.

6.4.2 Accepting blockchain technology in higher education

Throughout this study, it was observed that there is hesitance and even resistance from IT staff towards implementing blockchain-based applications, even those who know the benefit of using blockchain technology in higher education, as has been explained by Respondent 1 and a few other respondents. Meanwhile, Respondent 9 reveals that they resist new technology simply because they don't find the need to migrate when they don't find any problem with the existing system. When something is working fine the way it should be why change and build something new?

"The first thing we say is, do we really need it? Do we really want to build it ourselves?" **(Respondent 9)**

Meanwhile, Respondent 8 agrees with Respondent 9 when it comes to building or implementing blockchain-based solutions themselves. The respondents were clear about not wanting to build the blockchain-based solutions themselves.

"We don't want to build it ourselves, or at least I don't know of any products to buy" **(Respondent 8)**

The response aligns with the 'Perceived usefulness' construct of TAM which is covered in UTAUT's 'Performance Expectancy'. Which reflects the extent to which individuals believe that using the technology will enhance their job performance or provide benefits. The response about questioning the need to migrate to new technology indicates a consideration of the perceived usefulness of blockchain technology.

6.4.3 IT Staff interest in learning and adopting new technology

This section provides insight into IT staff's interest when it comes to learning new technology. Respondent 6 and Respondent 1 revealed that the University IT administrators are not aware of blockchain technology and do not understand it well enough to adopt it in their work or implement an application.

"I would say that most IT manager is not that into blockchain to have a general understanding, but probably not having done any implementation or deep research. Or deeper." **(Respondent 6)**

At the same time, Respondent 8 shows interest in learning the technology but worried about the cost and value that blockchain technology could provide at present.

"It's always interesting to explore new technology or or. I mean, there's nothing wrong it blockchain technology. The cost, I mean the interest and or the cost of implementing it is it's still kind of obscure. We don't really know if we were, if we want to implement it, we don't really know exactly what that would entail and we don't know of any" **(Respondent 8)**

These responses align with 'Perceived Behavioural Control' construct of UTAUT. The lack of understanding and knowledge among IT administrative staff, as mentioned by Respondent 6 and Respondent 1, may contribute to a lower perceived behavioural control. Without a solid understanding of the technology, they may feel uncertain about effective adoption and implementation of blockchain-based solutions.

6.5 Third-party involvement in developing blockchain-based applications for higher education.

This theme summarizes the respondents' intention of having a blockchain-based application developed by a third-party company rather than implementing it themselves. Respondent 8 emphasizes knowing the product and its use cases developed by a third-party

company which specialize in blockchain technology. This could help them in adopting blockchain in higher education and benefit from the technology without having to implement it themselves.

"I'm waiting for the big companies to use it and then we can implement it in our our own products." **(Respondent 8)**

Furthermore, Respondent 9 agrees with other respondents, and expects the experts in the field of blockchain technology to implement the application in a way it's easier to build or adopt it in their work rather than implement it themselves.

"I expect someone that should actually implement a blockchain algorithm should be someone that is really into that area into the area of algorithmic crypto graph, or what's it called. experts that work directly in the field of blockchain algorithms. And it's normal software developers that should use those products." **(Respondent 9)**

However, Respondent 6 explains how Ladok has been providing the necessary platform and support system for the universities in Sweden can implement a blockchain-based application that could be beneficial to the whole sector rather than one single university struggling to build it on its own. This will make sure the adoption of blockchain-based applications easier and more unified.

"Ladok is also moving forward to build more and more sector solutions that we can all use. So I think that it's it's, it's for the better I would say that we have the solution but also it means that the university like us probably feel like ah, let's let's not go forward doing this ourselves. Let's do this for the whole sector. Let's ladok let's make it ladok like priority to go forward" **(Respondent 6)**

The responses which highlight the understanding and knowing the product and its use case developed by third-party company align with UTAUT in terms of performance expectancy construct. Whereas the expectations of blockchain product developed by specialist aligns with TF since these individuals expect the technology which is adopted in the organization should not hinder the existing system of the organization.

6.6 Essential steps to increase the awareness level of blockchain technology in higher education.

This theme provides a summary of what Respondents think should be done to move blockchain technology forward from the theoretical or research environment to the adoption level. Like any new technology, the adoption of blockchain technology in higher education

may take a long time and the level of awareness of blockchain technology is currently low but growing at a slow pace. Respondent 2 suggests that there might be specific areas of education that could benefit from the blockchain and raising awareness of the technology may help to discover new opportunities.

"More awareness raised at a level if it can add value." **(Respondent 2)**

Furthermore, respondent 2 adds that the increasing importance of blockchain technology in various fields would require skill full professionals to meet the demand and currently, there may be a shortage of this.

"*Certainly, any IT sector, it'd be worth making sure that at least they have an awareness of distributed Ledger systems and decentralized networking algorithms and all the different major public blockchains that are being used for other things. Because, you know, there's going to be a labour market for it. Perhaps there'll be a shortage."* **(Respondent 2)**

The majority of respondents have suggested that the next step to increase awareness level and overcome future potential challenges associated with the technology is through more research on blockchain technology and relevant courses about the technology in the curriculum of the university.

"more research and education, of course, within the higher educational institutions and maybe offering more education within that area." **(Respondent 10)**

Meanwhile, respondent 7 emphasizes looking at blockchain technology as a piece of technology rather than associating it with Bitcoin and This could only happen with the help of education.

"A courses in the Curriculum make a workshop and make collaboration with other community with other university that work on the blockchain." **(Respondent 7)**

Furthermore, respondent 7 adds that cooperation between organizations and educational institutes could help to meet the demand of the labour market.

"the cooperation between the organizations, software, especially software organization and academia, is very important. So that the organization can for example. Uh, give recommendation to the university about which technology, which skills and. Uh, the student should have." **(Respondent 7)**

Although the majority of respondents agree that blockchain technology is important and can make a difference, It is clear that implementation is the biggest challenge. In Sweden, it is expected from Ladok or Sunet to take it forward and provide a unified platform for all the

universities in Sweden to make the adoption easier.

Meanwhile, Respondent 6 explains that nowadays, the platforms' complexity has become a big challenge for them to be an expert in knowing everything about it, since their focus has more become like user support, they would prefer to be a generalist and provide the necessary support needed by researchers and other stakeholders in higher education in helping them out to try out new technologies.

"Instead of doing everything yourself, we go back in time everything we did we did by ourselves nowadays, more reliable and taking external vendors in and because I think that the complexity and the largeness of the platform's altogether today is so big, so we can't be specialists. We have to be much other generalists and see to how can this benefit our, our, our needs, so, not so much specialists I wouldn't say go there." **(Respondent 6)**

"if the universities around the world were all willing to sign up for this kind of project, then there will be a huge advantage for anybody who wanted to check the accreditation of a given student, it'd be very, very easy." (**Respondent 5)**

"we want this arrangement to be so flexible and well oiled machinery that we do not want to have only contracts we want to be to it to be more flexible. So we set up a we set up a separate company that is only aimed at doing this between us" (**Respondent 5)**

While several Respondents suggest that the next initiation should be research and educational courses to increase the awareness level of blockchain technology in higher education Respondent 5 gives an improved suggestion to overcome the potential challenges being faced right now. According to Respondent 5 instead of blockchain being adopted by single individual or organization, it should be adopted and implemented in large scale by networks of universities or national entity. This will ensure that there will be financial and academic support to see the project through to completion and long-term use.

These responses align with UTAUT's constructs, where these respondents recognize the potential benefits of blockchain technology in higher education and emphasize the importance of increasing the awareness level by research, education and collaboration with organizations and support for successful adoption of blockchain technology in higher education in terms of performance expectancy, effort expectancy and facilitating conditioning constructs, as well as the Technological Frames theory.

7 Analysis

The author of this thesis study aimed to answer research questions: *What is the current level of awareness of blockchain technology among IT administrative staff and educators in higher education?* and *How can we take initiatives or steps to educate all stakeholders in higher education about blockchain technology?* In this section, the analysis will compare and contrast with the existing research literatures discussed in section 3 (previous research) with the findings of the study.

7.1 Understanding of blockchain technology

The study found that the respondents had different level of understanding and engagement with blockchain technology. The earliest implementation of blockchain technology is considered to be Bitcoin (Chen et al., 2022) and the initial knowledge of majority of participants has been also through Bitcoin and have explored it for research purpose or on personal interest. Meanwhile few of the respondents, particularly those in executive level have explored blockchain technology based on their professional interest and have understood its impact and challenges. It was also found that those who were less aware about the technology had difficulties in understanding blockchain due to lack of easily understandable and reliable sources of information.

It was found that those respondents who understand the technology agreed that it is a distributed ledger system that uses a consensus mechanism (Panagiotidis, 2022). They agree that blockchain's potential about secure storing data and emphasized its immutability (Delgado-Von-eitzen et al., 2021). One respondent has given a broader perspective to look into blockchain emphasizing that it can be interpreted and utilized in various ways, highlighting the importance of distributed ledger as a fundamental aspect of technology. Another respondent saw blockchain as an idea to build a secure, transparent and easy-to-use database.

Some respondents had experience with blockchain-based applications, such as cybersecurity audits and tracking tools for vouchers, conference participation, registration, and payments. However, there was a lack of awareness or exposure to real use cases and practical implementations of blockchain technology in higher education among half of the respondents. The study revealed diverse perspectives on blockchain technology and variations in perceived usefulness and performance expectations among the respondents.

7.2 Potential application of blockchain technology in higher education.

The findings of the study reveal that majority of the respondents even with varied understanding of blockchain technology agreed that the potential benefits of utilizing blockchain in higher education is certificate management especially in verifying and validating the certificates or diplomas. However, majority of the previous literatures (Delgado-Von-eitzen et al., 2021; Nousias et al.,

2022; Saleh et al., 2021; Lam & Dongol, 2022) has emphasized certificate management benefit along with providing use cases as illustrated in Table 1. The findings also suggest that the potential application of blockchain goes beyond certificate management like token transfer (Nousias et al., 2022; Lizcano et al., 2020; Turkanović et al., 2018; Bálint et al., 2019) and tracking various activities in universities, including payments, official processes and course deliverables. These finding provide a broader perspective on the possible application of blockchain technology to enhance transparency and efficiency within HEIs.

Another interesting finding of the study was credential validation where Respondent 4 discusses about OBEC project, which explores the use of blockchain technology to recognize individuals' competencies through digital badges. This initiative aims to certify skills and competencies acquired during education, including transferable or soft skills for individuals with diverse education backgrounds. Meanwhile, Respondent 6 also has highlighted the potential application of blockchain in credential validation, this will allow anyone who is interested to validate someone's credentials without having to involve the educational institution directly.

Additionally, Respondent 10 suggests the use blockchain in testing environment, where student's identities are masked, but evaluations remain transparent providing data security. This idea aligns with blockchain's transparency and immutability which can contribute to fair and unbiased evaluation processes. Meanwhile, Alipour et al., (2022) have proposed a model for academic assessment in education sector, which applies to academic material, including assignments, exams, aca-demic papers, etc to tackle issues related to potential personal bias. However, Delgado-Von-eitzen, Anido-Rifón & Fernández-Iglesias, (2021), Zhang et al., (2020), Aslan & Ataşen, (2020) and Saleh et al., (2021) emphasize on utilizing blockchain in HEIs to provide privacy and security for academic records from fraudulence.

7.3 Potential challenges of adopting and implementing blockchain technology in higher education.

The findings of the study reveals that there are several challenges that needs to be addressed prior to adoption and implementation of blockchain technology in higher education. One such potential challenge identified by the respondents was maturity level of blockchain technology. In order for easy adoption and implementation in higher education the blockchain technology needs to be mature enough. Since the technology is still in its early stage of development and there is need for further research and stability. The lack of maturity creates resistance within IT departments of higher education, making it difficult to move forward with blockchain initiatives. Mohammad & Vargas, (2022) have also highlighted the Immaturity of blockchain as Poor usability, Lack of scalability, Limited interoperability and standardization.

Additionally, the study also reveals cost is the major concern for implementing blockchain in higher education. Meanwhile, along with cost-effectiveness and Immaturity Mohammad & Vargas, (2022) have listed few more challenges such as privacy and security issues, Complexity of integration, Immutability and lack of flexibility and Data unavailability as technical barriers of blockchain technology. As per the findings of the study the cost highlighted by respondents represent the cost associated with learning new technology, establishing and maintaining the necessary infrastructure, the time investment required, and the labor-intensive nature of implementation. It was also found that it is financially burdensome for individual university to maintain the complex infrastructure of blockchain technology.

The challenges related to maturity level, cost and infrastructure complexity of blockchain technology highlighted by the respondents are considered to be the practical barriers that HEIs may face while considering the adoption of blockchain technology. Meanwhile, Mohammad & Vargas, (2022) discuss about organizational challenges such as Lack of adequate skills, financial barriers, and Lack of management commitment and support along with environmental challenges such as legal issues and a lack of regulatory compliance, the market and ecosystem readiness, and sustainability concerns associated with blockchain technology application in higher education. These findings reflect that there is a need for further research, development and simplification of blockchain solutions to facilitate easy adoption and implementation of the technology.

7.4 Awareness of blockchain technology in higher education.

The results of the study reveal several key findings regarding the awareness and acceptance of blockchain technology in higher education. While section 3.2 provides the factors contributing to the lack of awareness of blockchain technology based on existing literatures. The findings of this study provide practical factors contributing to the lack of awareness. It was found that the awareness level of blockchain technology in higher education is still low compared to finance sector (Surana & Bhanawat, 2022; Deepashika & Seneviratne, 2022), while awareness related studies are low in higher education context. Meanwhile, it was found there is lot of suspicion and misconception about blockchain technology due to its association with cryptocurrencies like Bitcoin. This has led to misunderstanding about blockchain technology, contributing to lack of awareness.

Additionally, the hesitance and resistance from IT staff of HEIs towards implementing blockchain-based applications were observed during the study. It was seen that some respondents questioned about the need to migrate to blockchain technology when the existing systems are functioning well enough. During the study it was observed that there is reluctance to build or implement blockchain-based solutions themselves, indicating a consideration of perceived usefulness and a preference for proven systems. However, some respondents expressed interest in

learning the technology but highlighted concerns about cost and the value it may provide at present contributing to knowledge gap.

These findings highlight the challenges associated with awareness, understanding, and acceptance of blockchain technology in higher education. The barriers faced while considering the adoption and implementation of blockchain-based solutions are Misunderstanding, credibility issues, hesitance, and knowledge gaps. Meanwhile, Surana & Bhanawat, (2022) and Deepashika & Seneviratne, (2022) discuss that accounting professionals in finance sectors are somewhat aware about blockchain technology and its application in finance sector. Deepashika & Seneviratne, (2022) also agree that blockchain technology still in its early stages and there is lack of academic and industrial research in India (Surana and Bhanawat, 2022). Surana & Bhanawat, (2022) and Deepashika & Seneviratne, (2022) also suggests that educating individuals in the industry about blockchain technology and its benefits could be beneficial to the financial sector.

8 Discussion

The study uses an exploratory approach along with the theoretical frameworks to investigate the level of awareness of blockchain technology in higher education and suggest necessary steps to be taken for the eventual adoption of blockchain technology in higher education. The study adds value to the existing literature by investigating the awareness level among the IT administrative staff and educators in higher education who would eventually benefit from blockchain-based applications by adopting the research projects or proposals which are currently available.

The results have been supported by the theoretical frameworks used to analyze the empirical data which are discussed in detail below. The theories used provides the general idea of new technology adoption in the social system which is useful in understanding the level of awareness about blockchain technology in higher education and steps to be taken to educate stakeholders in higher education.

8.1 Awareness of blockchain technology among IT administrative staff and educators in higher education

The study aimed to investigate the current level of awareness of blockchain technology among IT administrative staff and educators in higher education. The results indicate that blockchain technology is still in its early stages of adoption in higher education. The majority of respondents' initial knowledge of blockchain technology is based on research or heard it as buzzwords from other stakeholders in higher education. The diffusion of innovation(Venkatesh

Robert Smith et al., 2003) supports the findings, suggesting that blockchain technology is accepted and welcomed in the research community as a research topic and has not yet been widely adopted in higher education.

The respondents' perspectives involved in the study varies from early adopters who understand blockchain well enough to notice its potential benefits in higher education to lagers who have limited awareness and understanding of blockchain technology. Therefore, blockchain technology has still a long way to go to be widely adopted in higher education. This also makes it vital to address the level of awareness among various stakeholders in higher education. It is a crucial step towards facilitating the gradual adoption of blockchain technology in higher education.

8.2 Exploring Attitudes and Expectations of IT Administrative Staff and educators in Higher Education

The results indicate that IT administrative staff, who play a crucial role in technology adoption in higher education had a low level of awareness of blockchain technology. The UTAUT/TAM (Venkatesh Robert Smith et al., 2003) and TF (Orlikowski & Gash, 1993) theories align with these findings, revealing the willingness of IT administrative staff to notice and accept blockchain technology in their work, but expect it to be easy to use, already mature and cost effective. Based on the responses from the respondents it is necessary to address the challenges mentioned in the result section to ensure blockchain technology is more widely adopted in higher education.

The results reveal that the majority of IT staff are reluctant to notice the technology and are far behind in acceptance unless it is demanded from them. The one who understands the technology and its potential application in higher education does not want to build or implement the application on their own. It is also identified that the perceived usefulness of blockchain technology is not identified or given priority to understand since the system being used by the IT staff currently is seen as more useful and mature in comparison.

Additionally, the UTAUT (Venkatesh Robert Smith et al., 2003) suggests that the attitudes of respondents involved in the study varied about blockchain technology. While the early adopters emphasized implementing the research proposals or solutions to use blockchain technology in higher education and the majority of IT staff preferred someone else to build or implement the application and illustrate it with the actual use case of their application. It was also observed that even though the attitude varied among the respondents, they agree upon having a unified system applicable to all universities in Sweden.

Furthermore, the purpose of blockchain in higher education and expectations from it were not clear to some respondents. They may not prioritize blockchain over other important tasks that are necessary to keep the University system stable, as indicated by the TF (Orlikowski & Gash, 1993) theory.

Based on the findings it is seen that blockchain technology is relatively new and it is difficult to predict its outcomes and potential benefits without conducting research and implementing the research proposals. To overcome this, it is critical that all stakeholders understand the purpose of blockchain technology in higher education and its potential benefits. This will help educators and IT staff align priorities and build a unified vision, facilitating the adoption and integration of blockchain technology in HEIs.

8.3 Key findings and recommendations

This study adds to the existing literature by analyzing the current level of awareness of blockchain technology among higher education IT staff and educators. It is crucial to understand the level of awareness of blockchain technology among stakeholders in order to understand their attitudes and behavior prior to its potential implementation in the area. According to the findings, there is a low level of awareness of blockchain technology in higher education, and stakeholders' attitudes about its possible implementation vary. The study additionally sheds some light on how respondents perceive blockchain technology in terms of how it is perceived, its potential application, the challenges associated with it, and what is expected of it in the context of higher education.

An unexpected result of this study has been the need for invisible implementation. Where the technology is implemented in such a way, as to make it seem natural without focusing on the technology, but focusing on its use instead. Similar to how mobile phones and the Internet are a part of everyday life now. Blockchain technology use cases could also become a way of implementing complex verification and validation use cases. It is also clear that not everyone wants to implement it, the cost and complexity involved means that the use of this technology and implementation make it “worth” it only if more people use it. So, a university should not implement it, rather an organization like Ladok which serves all universities in Sweden should implement it instead. This also reduces the risk of the organization changing direction or shutting down, invalidating the long-term use of this technology and there will be financial and academic support.

Based on the findings, it is recommended that in order to promote the implementation

of blockchain technology in higher education, the level of knowledge of the technology among potential stakeholders should be increased. This could be accomplished by conducting workshops and educational courses in higher education. More study is also required to address the challenges related to blockchain technology and find solutions to overcome them. These recommendations are created with the understanding that blockchain technology is gaining interest from a variety of sectors, and it is critical to offer educational courses or programs regarding the technology to ensure that every field benefits from it.

9 Conclusion

The study aimed to investigate the current level of awareness among IT administrative staff and educators in higher education. The findings highlight that the level of awareness of blockchain technology in higher education is low and found varying attitude towards the technology. The study recommends workshops and educational courses in higher education to increase the awareness level among various stakeholders in higher education to minimize the misconception or misunderstanding towards blockchain as well as to ease up the gradual adoption of blockchain in HEIs.

Additionally, the study uncovers the need of invisible implementation, emphasizing the importance of focusing on the practical implementation of blockchain than understanding its technical aspects in context of higher education. It was also identified that the implementation approach should be unified, suggesting that organization like Ladok which serves all universities in Sweden would be better suited to implement blockchain technology to ensure long-term stability. Furthermore, the study also recommends future investigation on blockchain technology to understand its long-term impact in various field including HEIs, user acceptance and behavior, and other challenges or barriers associated with it. The study also illuminates the importance of understanding how the potential stakeholders perceive the underlaying agenda of a potential forthcoming technology by questioning the purpose of what it will serve, Rationalization of costs and improved quality of service.

One major factor that the study finds is the cost of working with blockchain. Since blockchain is not yet mainstream, there is a need for investment to grow the field overall. This includes spending time, resources and research into developing easy to use implementations of blockchain which would help HEIs provide services in a secure, transparent manner. Providing all the benefits of blockchain, while keeping all the complexity for a few experts to resolve.

10 References

Alipour, S., Elahimanesh, S., Jahanzad, S., Morassafar, P., & Neshaei, S. P. (2022, April 27). A Blockchain Approach to Academic Assessment. *Conference on Human Factors in Computing Systems - Proceedings*. https://doi.org/10.1145/3491101.3519682

Aslan, B., & Ataşen, K. (2020). *MANAS Journal of Engineering A blockchain based lifelong learning platform: The Smart University*. www.journals.manas.edu.kg

Bálint, K., Cvetković, D., Takács, M., Holik, I., & Tóth, A. (n.d.). Connecting Bitcoin Blockchain with Digital Learning Chain Structure in Education. In *Acta Polytechnica Hungarica* (Vol. 16, Issue 1).

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Bryman Alan. (2012). *Social Research Methods*.

Chen, W., Bohloul, S. M., Ma, Y., & Li, L. (2022). A blockchain-based information management system for academic institutions: a case study of international students' workflow. *Information Discovery and Delivery*, *50*(4), 343–352. https://doi.org/10.1108/IDD-01-2021-0010

Daraghmi, E. Y., Daraghmi, Y. A., & Yuan, S. M. (2019). UniChain: A design of blockchain-based system for electronic academic records access and permissions management. *Applied Sciences (Switzerland)*, *9*(22), 1–27. https://doi.org/10.3390/APP9224966

Deepashika, N. W., & Seneviratne, C. (2022). *The Investigation of the Awareness of Implementing Blockchain Technology in Audit Trails among the Auditors*. https://doi.org/10.24815/jaroe.v5i2.26587

Delgado-Von-eitzen, C., Anido-Rifón, L., & Fernández-Iglesias, M. J. (2021). Application of blockchain in education: GDPR-compliant and scalable certification and verification of academic information. *Applied Sciences (Switzerland)*, *11*(10). https://doi.org/10.3390/app11104537

Delgado-Von-eitzen, C., Anido-Rifón, L., & Fernández-Iglesias, M. J. (2021). Blockchain applications in education: A systematic literature review. In *Applied Sciences (Switzerland)* (Vol. 11, Issue 24). MDPI. https://doi.org/10.3390/app112411811

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a Revised Theoretical Model. *Information Systems Frontiers*, *21*(3), 719–734. https://doi.org/10.1007/s10796-017-9774-y

Fedorova, E. P., & Skobleva, E. I. (2020). Application of blockchain technology in higher education.

European Journal of Contemporary Education, *9*(3), 552–571. https://doi.org/10.13187/ejced.2020.3.552

Fitzner, K. (2007). Reliability and validity: A quick review. In *Diabetes Educator* (Vol. 33, Issue 5, pp. 775–780). https://doi.org/10.1177/0145721707308172

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. In *British Journal of Educational Technology* (Vol. 50, Issue 5, pp. 2572–2593). Blackwell Publishing Ltd. https://doi.org/10.1111/bjet.12864

Gupta, S., Abbas, A. F., & Srivastava, R. (2022). Technology Acceptance Model (TAM): A Bibliometric Analysis from Inception. *Journal of Telecommunications and the Digital Economy*, *10*(3), 77–106. https://doi.org/10.18080/jtde.v10n3.598

Lam, T. Y., & Dongol, B. (2022). A blockchain-enabled e-learning platform. *Interactive Learning Environments*, *30*(7), 1229–1251. https://doi.org/10.1080/10494820.2020.1716022

Lizcano, D., Lara, J. A., White, B., & Aljawarneh, S. (2020). Blockchain-based approach to create a model of trust in open and ubiquitous higher education. *Journal of Computing in Higher Education*, *32*(1), 109–134. https://doi.org/10.1007/s12528-019-09209-y

Ma, Y., & Fang, Y. (2020). Current status, issues, and challenges of blockchain applications in education. *International Journal of Emerging Technologies in Learning*, *15*(12), 20–31. https://doi.org/10.3991/ijet.v15i12.13797

Majdoubi, D. El, Bakkali, H. El, Bensaih, M., & Sadki, S. (2022). A Decentralized Trust Establishment Protocol for Smart IoT Systems. *Internet of Things (Netherlands)*, *20*. https://doi.org/10.1016/j.iot.2022.100634

Mohammad, A., & Vargas, S. (2022). Challenges of Using Blockchain in the Education Sector: A Literature Review. In *Applied Sciences (Switzerland)* (Vol. 12, Issue 13). MDPI. https://doi.org/10.3390/app12136380

Myers, M. D., & Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization*, *17*(1), 2–26. https://doi.org/10.1016/j.infoandorg.2006.11.001

Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball Sampling: A Purposeful Method of Sampling in Qualitative Research. *Strides in Development of Medical Education*, *14*(3). https://doi.org/10.5812/sdme.67670

Nousias, N., Tsakalidis, G., Michoulis, G., Petridou, S., & Vergidis, K. (2022). A process-aware approach for blockchain-based verification of academic qualifications. *Simulation Modelling Practice and Theory*, *121*. https://doi.org/10.1016/j.simpat.2022.102642

Orlikowski, W. J., & Gash, D. C. (1993). *Technological Frames: Making Sense of Information Technology in Organizations*.

Oye, N. D., A.Iahad, N., & Ab.Rahim, N. (2014). The history of UTAUT model and its impact on ICT acceptance and usage by academicians. *Education and Information Technologies*, *19*(1), 251–270. https://doi.org/10.1007/s10639-012-9189-9

Panagiotidis, P. (2022). *Issue 1online) European Journal of Education*. *5*(1), 66–82. https://doi.org/10.26417/443gjm83

Saleh, O. S., Ghazali, O., & Idris, N. B. (2021, January 29). A New Decentralized Certification Verification Privacy Control Protocol. *2021 3rd International Cyber Resilience Conference, CRC 2021*. https://doi.org/10.1109/CRC50527.2021.9392485

Surana, G., & Bhanawat, S. S. (2022). Awareness of Blockchain Technology-Based Accounting System Among Professionals †. In *The IUP Journal of Accounting Research & Audit Practices* (Vol. 21, Issue 4).

Turkanović, M., Hölbl, M., Košič, K., Heričko, M., & Kamišalić, A. (2018). EduCTX: A blockchain-based higher education credit platform. *IEEE Access*, *6*, 5112–5127. https://doi.org/10.1109/ACCESS.2018.2789929

Venkatesh Robert Smith, V. H., Morris, M. G., Davis, G. B., & Davis Sam M Walton, F. D. (2003). *Qarterly USER ACCEPTANCE OF INFORMATION TECHNOLOGY: TOWARD A UNIFIED VIEW^* (Vol. 27, Issue 3). https://doi.org/10.2307/30036540

Zhang, L., Ma, Z., Ji, X., & Wang, C. (2020). Blockchain: Application in the System of Teaching Informatization Management of Higher Education. *Proceedings - 2020 3rd International Conference on Smart BlockChain, SmartBlock 2020*, 185–190. https://doi.org/10.1109/SmartBlock52591.2020.00041

11 Appendix

11.1 Informed Consent:

The study is to understand the **level of awareness of blockchain technology among IT administrative staff and educators**. This study aims to get some insights into the current level of awareness and understanding of blockchain technology among IT administrative staff and educators. This study will help the future adoption of blockchain technology in higher education and help to inform future educational programs and training initiatives related to blockchain technology.

The interview duration will be approximately an hour and based on your preference you can interview in person or remotely via Teams or Zoom. The interview will be audio- recorded for future analysis, and confidentiality and anonymity will be maintained throughout the study. You are free to leave the interview whenever you feel like it during the session. I appreciate greatly your participation and your valuable input for my thesis.

11.2 Interview guide:

Title: "Investigating the Level of Awareness of blockchain technology in higher education"

Place: The interview was conducted via Zoom, Teams, and in person based on the Respondent's preference, available time, and distance.

Time taken: Each interview took approximately 30-40 minutes.

Method (Semi-structured interview): The following questions were asked to each Respondent; a few questions may be skipped if the Respondent has already answered the question. Based on the Respondent's answer follow-up questions are asked. Before starting the interview, a short introduction about the topic and the need for the study is given. Took permission from the Respondent for recording the conversation before the first question.

10.2.1.1 Technological Frames:

1. How did you learn about Blockchain Technology?

   A. Could you please elaborate on it? What is it? How does it work?

2. Have you come across any blockchain-based applications in higher education? If yes, could you explain their use and impact?

10.2.1.2 Diffusion of Innovation:

3. What kind of role do you think will blockchain technology play in higher education?

10.2.1.3 TAM and UTAUT:

4. Have you used blockchain-based applications in previous or present work?
5. In your opinion, what are the possible applications of blockchain technology in higher education?
6. In your opinion are there any challenges or barriers to applying blockchain-based applications in higher education?
7. In your opinion what kind of skills or knowledge do you expect from educators and administrative staff in higher education to be able to: implement blockchain technology in higher education?
8. In your opinion do you think awareness of blockchain technology is increasing among IT administrative staff and educators?
9. What do you think are the challenges of being aware of blockchain technology in higher education?
10. What do you think you would need to increase the awareness of blockchain technology in higher education?

This was the end of the interviewer's questions and asked the Respondent if they can add more to the topic and ended the recording with a Thanking the Respondent for their willingness to participate and the time taken for that.

12 Opposition report

12.1 Report /Thesis

Exploring Perceptions of Educators about ChatGPT in Higher Education

Irobun David Ikponmwen

12.2 Reviewing student

Divya Jagannatha

12.3 Contents of the opposition

12.3.1 The Thesis in General

When it comes to language the author mostly present fluent and understanding thesis. The text citations are inconsistent for example (Cooper, 2023, Mohammadreza et al., 2023, Sok and Heng, 2023) in which the separation for each article the author uses comma and it would be better to use a semicolon. The formatting of the thesis could be improved though Author uses Times New Roman font and size 12 but general formatting lacks polish like line and paragraph spacing, text alignment.

12.3.2 Abstract

It is noted that the thesis lacks an abstract. An abstract is essential for readers to quickly grasp the research's background, methods, significant findings, and conclusions. I request that the abstract be completed in order to improve the overall quality of the thesis and increase reader interaction with the work.

12.3.3 Introduction

The Introduction provides a clear and detailed history and development about chatbot and creates a story around that grabs the attention of reader and keeps them interested in the thesis. It also shows the rapid development of ChatGPT and highlights its positives in a good way. However, the introduction lacks clear and focused approach. It needs to focus more on educators' perspective of ChatGPT and its influence in higher education. It is also noticed that the introduction does not provide justification for purpose of conducting the study.

The author has tried to illustrate the popularity curve of ChatGPT worldwide. However, the figures (Figure 1, 2, and 3) provided in the introduction to show the popularity of ChatGPT does not depict the adoption curve of ChatGPT in higher education context. However, it was also noticed that the illustrated curve in the figures have problem with timeline, as the

introduction states that the free version of ChatGPT was released in November 2022, while the figures indicate data starting from May 2022.

12.3.4 Suggestions to improve the introduction?

1. Provide an overview of the importance and implications of researching educator views in the context of higher education.
2. Provide a graph which is significant for the research question and highlight the importance of the usage of the figures.
3. Adding a graph of Generative AI would be appropriate since ChatGPT is just a product of it.

12.3.5 Purpose and Research Question

Purpose is brief and easy to understand. Research question is also brief and easy to understand. However, the purpose statement of the thesis does not provide the specific objective of the thesis. It was also noticed that the purpose statement does not justify the need of investigating the perception of educators about ChatGPT in higher education. It is important to clearly state the objective of the thesis and justify the need of the conducted study.

Section 1.2

The author should focus on keeping the thesis tone neutral while various sections of the thesis. An example has been given to illustrate this from section 1.2.

Example: *By synthesizing the discussions and identifying the overarching themes, this research aims to contribute to the ongoing dialogue and support evidence-based decision-making for the effective integration of ChatGPT in higher education.*

12.3.6 Theoretical Framework

The author uses established theory to analyse the findings and significance is a good approach. The use of SCOT framework in this study seems apt and well thought out. The introduction of the framework and its smooth connection to ChatGPT is well written. However, it was noticed that the statement given in the example 1 is conflicting with the research question, where the research question is to understand the perspective of educators about ChatGPT in higher education but the statement talks about understanding the integration of ChaGPT in higher education. Another statement which is directed towards different direction than research question is illustrated in example 2. Maintaining consistency

throughout the thesis is important.

Example 1: *A brief discussion on the social construction of technology as the primary theoretical perspective and its relevance to understanding the integration of ChatGPT in higher education is provided*

Example 2: *We can investigate how educators negotiate and adapt ChatGPT to align with their pedagogical goals, institutional contexts, and disciplinary requirements.*

12.3.7 Literature review

The research topic is new and identifying related research is difficult but author has tried to identify relevant literature for their research topic. However, below few suggestions are given to improvise the section.

1. Instead of this heading 'Review of Literature Related to Perceptions on ChatGPT', the author can just mention 'Literature review' and give an introduction of what to expect in the section for the reader.
2. 'Perceptions of the benefits of ChatGPT' Section number is missing.
3. These sub-sections are lengthy and difficult for the reader.
4. When the author uses text citation of 2-3 articles for a statement. The author uses comma instead of semicolon which needs to be edited.
5. It will look better if the captions are below the table not above the table.

12.3.8 Research Methodology

The author could provide brief introduction of what kind of method has been used for data collection.

Data Collection

1. What is qualitative analaysis?
2. The author needs to provide justification for using blogs for data collection and usage of qualitative analysis.

Related Literature Selection Process

The process of literature selection is vaguely explained. It would be good to know how many articles has been used in the literature review of this thesis study. While the author mentions about how many articles has been found from 3 different databases, but there is no

clear mention of how many of them are used and what was the selection criteria for those articles for which a flow chart or PRISMA diagram would have served the purpose. Along with it a table with inclusion and exclusion criteria would be a fit in this section.

Research Data Source Selection Process

The author has explained in detail regarding the choosing of blogposts for data collection. However, table 4 is empty which should have given details on the author's qualification and dates of the post published and updated date.

Data Analysis

It would be nice to provide justification for using Thematic analysis. Along with it the author has mentioned emerging themes while not clearly stating how the themes has emerged and the process of identifying the themes.

Ethical consideration

It is commendable that the author has provided extensive and detailed explanation of ethical consideration in the thesis. The detailed attention given to ethical considerations demonstrates a strong commitment to protecting the rights and privacy of the video bloggers utilized in the research.

12.3.9 Validity and Reliability

The thesis is missing validity and reliability section in relation to the study.

12.3.10 Results

The author has commented the findings based on the theoretical framework and tried to analyse the findings in relation to established theory which is good.

1. The tense used in this section is not correct, use of "will" indicates that analysis has not been done.

   Example: Based on the research topic and more so the research question for this study, a comprehensive thematic analysis of the blogs selected in Section 2.1.1 will be conducted.

   Instead of highlighted statement using like this "Based on the research topic and the research question for this study, a comprehensive thematic analysis of the blogs selected in Section 2.1.1 was conducted." would be better.

2. It would be good to have an introduction about the identified themes and little rephrasing would make it better.
3. It is repeatedly mentioned “aspects of these sub-theme include” and given some points, but this indicates, more information before. “include” can be changed to “contains” or similar?
4. Inconsistent formatting in quotes.
    a. A few start with the word “Quote”
    b. A few are quoted and italicized but not all.
5. The statements are not very objective, but are biased towards ChatGPT. A few quotes which talk about drawbacks are not clearly analysed.

    “*Cheating and academic integrity: ChatGPT raises concerns about cheating by generating content for students, challenging traditional assessment methods, and the ability to detect academic dishonesty.”*

    In the above statement, Does ChatGPT raise the concern? Or is it raised by the blogger?

    But aren’t these assessment methods already changing with tools like GPTZero, should that argument be made here?
6. A lot of the blog comments seem to be personal opinions with no basis, this challenges the objectivity of the data.

    "Recommended assessment types to mitigate AI use... Group projects: Students are less likely to cheat if they work in groups. Task students with a project that interests them in a group format."

    The above quote for example has no way to know if group project will actually reduce cheating, but simply assumes it will with no proof
7. No quotes from the analysed data from the section 3.5 onwards. Only statements from the author.
8. Again from section 3.5 biased towards ChatGPT and not objective. Only talks positive without any data.
9. Section 3.5.2 discusses AI in a more generic sense and not specifically about ChatGPT itself, creating a distraction from actual research.

    Example: personalized feedback alongside AI assistance.

12.3.11 Discussion and conclusion

The author talks about comparing the findings with the existing literature for the discussion which is appreciated. However, the section of comparing the finding with existing literature is missing. Along with it the Discussion and conclusion does not exclusively answer the research question and lack in discussion on the findings of the thesis. The conclusion sounds like general rather than in terms of research question.

12.3.12 References

The reference list in alphabetical order and the references seem relevant to the study.

The author has also mentioned the reference list is need to be edited in Harvard style.

12.3.13 Appendices:

The appendices in the thesis contains “Chat with the AI chatbot, ChatGPT (March 23, 2023, release version)” which is not in relation with the research question and utilizing it should be justified.