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RESEARCH ARTICLE

Educhain: A Study on the Transformative Role of Blockchain Technology and its Potentials in Higher Education

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ABSTRACT

The blockchain technology, characterised by its decentralised and transparent ledger system, has attracted remarkable attention due to its potential to bring about revolutionary changes across various fields. Applications of blockchain technology in the field of higher education show promise for enhancing security, transparency, and efficiency. This research is to investigate views on the blockchain technology potential in the education sector from a variety of higher education stakeholders, including administrators, teachers, and college students at different academic levels. This study recruited a sample of 509 participants from different universities in Saudi Arabia. The statistical techniques used for data analysis are percentage analysis, MANOVA (Multivariate Analysis of Variance), and correlation analysis. The study's conclusions show that the participants had a fair amount of knowledge about how blockchain technology is being used in higher education. Also, it was shown that there is no discernible correlation between the participants' demographics and their opinions on the possibilities of blockchain technology in the context of higher education. To create a successful educational system, the study suggests integrating blockchain technology into higher education.

INTRODUCTION

Higher education is one of the many industries that have seen dramatic and disruptive changes due to the technological advancements of the digital age. Academic procedures at higher education institutions have undergone a substantial transformation with the integration of digital technologies. This comprises an extensive variety of tasks, which includes the digitization of academic records, including assignments and examinations. This technological advancement has resulted in a more efficient and improved grading procedure. As technology develops, there is an increasing interest in investigating cutting-edge approaches to further transform higher education, such blockchain technology, which is renowned for being secure and decentralised.

Blockchain Technology

Blockchain is described as a decentralised and scattered ledger scheme used to record transactions through several computers so that the record cannot be altered retroactively without the modification of all subsequent blocks and the agreement of the network by the National Institute of Standards and Technology (Yaga et al., 2018). Tapscott and Tapscott (2018) defines blockchain as "an incorruptible digital ledger of economic transactions that can be configured to record not just

financial transactions but virtually everything of value"(p. 81). With a broader perspective, United Nations Educational, Scientific and Cultural Organization (UNESCO) defines blockchain as a "shared, decentralized, and secure ledger technology to record and store digital transactions of almost any digital assets including digital identities, medical and educational records, birth and marriage certificates, skill credentials and digital contracts" (Grech et al., 2022: p. iii).

The blockchain technology offers a robust and decentralised mechanism for distributing information securely, which has potential applications in various domains, including the field of education. Yet, even while blockchain technology has demonstrated promise in improving efficiency and transparency across several industries, it is unclear how the public understands this technology (Astaman & Mauritsius, 2023). The blockchain technology initially emerged as a mechanism to regulate Bitcoin, but it has since progressed to the extent of being acknowledged as a foundational technology for diverse decentralised applications (Arishi et. al., 2018; Mitchell et. al., 2019).

The blockchain technology is characterised by its decentralised nature and its ability to maintain an unalterable database composed of a series of interconnected blocks. These blocks contain crucial information such as transaction dates, timestamps, volumes, and players involved (Mohammad & Vargas, 2022). Blockchain technology can be described as a decentralised database that securely and permanently records transactions between many entities in a manner that cannot be altered (Antonaci et. al., 2019). This entails synchronising their blocks through a consensus process with the data stored by other users. (Razia, 2022). The utilisation of blockchain technology enables students to engage in interactions with colleagues and mentors who possess a higher level of knowledge and expertise (Androutsos, & Brinia 2019; Fenichel & Schweingruber, 2010).

The three most prevalent types of blockchains are public, private, and permissioned (Delgado-von-Eitzen et. al., 2021). Cryptocurrency networks, as well as corporate and public organisations, frequently employ these entities. Public networks are accessible to all individuals that wish to participate in the peer-to-peer network, thereby making them permissionless in nature (Yaga et al., 2018; Tapscott and Tapscott, 2018; Antonopoulos, 2016). Public blockchains are characterized by open participation, transparency, and decentralization (Tapscott & Tapscott, 2016). Public blockchains are often used for applications that require a high degree of trust and security, such as cryptocurrency transactions (Taleb, 2018). In private networks, participants can only be admitted if they get an invitation, indicating that they have been granted permission to attend. The network is governed by regulations established by the overseeing organisation. Private blockchains are permissioned blockchains that are controlled by a single organization or group of organizations (Mougayar, 2016). Private blockchains are often used to store sensitive data or to control access to certain resources (Poon & Buterin, 2016). Private blockchains can offer increased privacy and security compared to public blockchains (Tapscott & Tapscott, 2016). A permissioned blockchain is consortium that is a composite entity that incorporates elements from both preceding kinds. Consortium blockchains are permissioned blockchains that are controlled by a consortium of organizations (Swan, 2015).

Blockchain Technology in Higher Education

The challenges related to safe data storage are becoming more widely acknowledged as digitization becomes more and more common in the field of higher education. Blockchain technology is utilised in the enhancement of higher education and the establishment of an educational framework to facilitate learning (Bhaskar et al., 2021). Hence, the process of integrating blockchain based technology in an educational process can be called educhain (Liu et al., 2021). In the realm of science education, novel approaches to learning frequently encompass prolonged periods of solo investigation, immersive social engagement with like-minded communities, and the guidance of experienced mentors (Kuleto et. al., 2022). The implementation of blockchain technology is a crucial factor in ensuring data validity and accurate record keeping. (Vidal et al., 2019).

The application of blockchain technology has been suggested as a possible remedy to some major problems that higher education needs to deal with (Huang, et. al., 2022). The primary applications of blockchain technology are in the issuance and verification of academic credentials, such as transcripts, diplomas, and accomplishments, as well as other professional credentials that are approved by global employers (Alammary et. al., 2019). These obstacles include the efficient management of graduation records and the adoption of a student-centric approach (Fedorova & Skobleva 2020; Kamišalić et. al., 2019). Blockchains exhibit variations in their design and structure, resulting in numerous varieties. The regulation of data included within blockchain blocks and the activities performed by multiple parties on the blockchain can be determined based on the configuration and anticipated outcomes of the blockchain, aligning with the intended business objectives (Gabrielli et. al., 2022).

Whole transcripts, including learning objectives and content, academic accomplishments, university degrees, experience, competitions, and personal hobbies, may be safely stored and retrieved using blockchain technology (Bucea-Manea-Tonis et al., 2021). Blockchain technology has the potential to expedite the verification of student credentials, including degrees, transcripts, performance, and professional qualifications (Fedorova & Skobleva, 2020). Blockchain-based platforms allow students own and control their certificates without an intermediary. Subsequently, the use of blockchain technology enables institutions of higher learning to efficiently reduce administrative expenses and expedite bureaucratic processes (Chauhan & Patel, 2022). The blockchain has promise for application in several domains, including the easing of student loan disbursement, the distribution of research and grant funds, the optimisation of certificate verification procedures, and the creation of an online Lifelong Learning Passport. Blockchain record-keeping is an extra project that universities are working on (Fedorova & Skobleva, 2020).

The technology possesses a multitude of applications, including safeguarding certificates in a lasting manner, verifying certification, automating credit recognition, and managing intellectual property (Kosmarski, 2020). This is achieved through the implementation of a digital signature mechanism and the utilisation of the time-stamping feature of blockchain to deter illicit acts carried out by diploma issuers. (Chauhan & Patel, 2022). Furthermore, the properties of integrity and immutability inherent in blockchain technology facilitate the accurate recording of diploma data and enable the tracking of any modifications made to these records (Huang et. al., 2022).

PRIOR STUDIES

General purposes of blockchain in education

There is a growing interest in blockchain within educational sectors for different purposes. Alalyan et al. (2023) categorized these purposes into three focuses: organisation, student, and both. At organizational level, some purposes were cost reduction of operations and data managements, processes automation, and enhance data security (Alammary et al., 2019; Haugsbakken & Langseth, 2019). For students focus, some reasons were new methods of course delivery and assessment, Learning is earning' approach, better organisation of knowledge and learning (Alalyan et al., 2023; Alammary et al., 2019; Raimundo & Rosario, 2021).

Adoption studies of blockchain in education

The value driver perspective, theory of reasoned action, and technology acceptance model are some of the theoretical frameworks that have been used to analyse the implementation of blockchain technology in education (Alalyan et al., 2023). These frameworks aim to understand key factors shaping user acceptance and usage of new technologies. Several studies have examined students' and educators' perceptions of blockchain and its applications in academic settings.

Astaman & Mauritsius (2023) found that students view blockchain positively overall and recognize its potential for verifying qualifications, managing learning, enabling inclusion, supporting distance learning, and distributing educational assistance. However, acceptance depends on various factors. Ullah et al. (2021) identified perceived usefulness, ease of use, compatibility, and trust as significant predictors of blockchain adoption for smart learning environments. Tonis et al. (2021) also found that student motivation strongly impacts collaborative work quality, which in turn improves student learning outcomes.

While perceived benefits are important drivers, challenges remain regarding blockchain acceptance in education. Park (2021) reviewed blockchain adoption during 2017-2020, citing concerns around usability, security, legal issues, values conflicts, and the political governance of blockchain platforms. Thus, both technological and social factors shape the integration of blockchain into academic settings. Further research could fruitfully examine interactions between the utility afforded by blockchain applications and the organizational contexts into which they are introduced.

Applications of blockchain in education

The educational applications of blockchain covered different dynamics of educational practice including managing students' records, digital transcripts, secure and instant payments, and copyrights protection (Paul et al., 2022). In another application, Razia (2022) found that blockchain credentials through Blockcerts platform enable the sharing of admission procedures, thereby providing students with the opportunity to apply to multiple colleges. Blockchain credentials found to support lifelong learning through providing learners with the opportunity to own and share their achievement. In the same vein, Arndt & Guercio (2020) are leading ongoing evaluation of two applications of a blockchain-based university transcript system to support students' mobility across educational institutions.

Regarding HEDU-Ledger, Ayub Khan et al. (2021) addressed security and privacy concerns in Higher Education Commission (HEC) degree attestation and record traceability by presenting a decentralised solution leveraging blockchain, specifically Hyperledger fabric. The proposed architecture ensures robust security through a permissioned private network, enhancing blockchain's immutability, cryptographic encryption, and smart contracts for decentralized candidate degree credential management while ensuring transparency and resilience in relation to cyberattacks.

Bhaskar et al. (2021) carried out a comprehensive review investigating the several ways that blockchain technology may be used in education. This study highlights areas for additional investigation and application in the field of education, offering educational stakeholders a fundamental resource. Raimundo and Rosário (2021) carried out a systematic review to investigate the applications of blockchain technology in higher education. Their conclusions suggest that the decentralised execution and immutability of smart contracts improve e-security, learning's trustworthiness, and transparency, which in turn improves assessment transparency and curriculum design. In their systematic assessment of the literature on blockchain applications in education, Loukil et al. (2021) categorised the results into categories related to educational applications and the advantages of integrating blockchain technology. They report a list of blockchain-based applications created with education in mind and emphasises the possible advantages of blockchain technology for the field of education. Further investigating the uses of blockchain technology in education, Delgado-von-Eitzen et al. (2021) focused on topics including learning management systems, educational payments, and identity and credential management. The study identified the transformative possibilities of blockchain within the education sector, while also identifying critical challenges.

Finally, to improve security and cut down on red tape, Palma et al. (2019) presented a blockchain-based solution for digitising academic credits and degree certificates in Brazilian higher education.

While innovative, the study requires further scrutiny on scalability, integration, and potential institutional resistance to ensure practical viability and sustained improvement in the education system.

Blockchain's potential, advantages, and difficulties in education

Blockchain technology offers the education industry a lot of possibilities. Guo et al. (2020) presented a system integrating public and private blockchains with three different smart contract schemes for digital rights recording, secure storage, and certificate verification. This allowed for Blockchain-enabled digital rights management for online education multimedia resources. According to the study, a blockchain-based system holds the potential to successfully protect multimedia data in the context of online learning.

Nevertheless, Mohammad & Vargas (2022) examined the obstacles to blockchain integration in education and classified them into three categories: technological, organisational, and environmental. The results of this study are consistent with other studies that have found a tendency towards a greater focus on examining technical barriers. Yet, this highlights a glaring disregard for the organisational and environmental factors that affect the adoption of blockchain technology in the field of higher education.

Pandey (2021), on the other hand, investigated the significant advantages of integrating blockchain technology into education, highlighting its potential to strengthen security, empower students, and increase productivity for corporations, educational institutions, and students. The study also discussed specific applications within education, including initiatives for certification and identity management, along with mechanisms that incentivize lifelong learning, while also addressing multifaceted challenges focusing legal considerations, scalability issues, data privacy and security concerns, market adoption, and innovation issues. In the same context, Sood et al.(2020) identified key characteristics of blockchain such as decentralization, immutability, pseudonymity, and self-sovereignty and highlights their potential application in addressing challenges within higher education, particularly in the context of unbundling, providing valuable insights for universities considering modularizing their offerings and for businesses aiming to develop blockchain solutions for the education sector. Haugsbakken & Langseth (2019) highlight the blockchain possible benefits in terms of speed, efficiency, and transparency. They identified three potentials of integrating blockchain technology in education as they are democratizing and automating the learning process, examining its capacity to alleviate costly bureaucratic processes and considering its suitability as a digital technology for higher education. The study also critically acknowledges several challenges associated with implementation, such as environmental costs, potential sluggishness as blockchains expand, issues related to trust and legal aspects, and the uncertainty related to long-term viability of the technology.

Similarly, Yakovenko et al. (2019) looked at how blockchain technology could be used to modernise procedures, save energy and time when processing information, and deal with issues that arise when educational institutions switch to digital media, which calls for adjustments to infrastructure, staffing, financial procedures, and management styles.

Further, Ocheja et al. (2021) undertook deeper research of blockchain technology, providing insights into its evolution, emerging themes, and real-world case studies involving adoption and integration with the current educational setting. The study primarily focused on identifying major factors, participation of stakeholders, current trends, unexplored areas, and potential innovations, highlighting a remarkable application of issuing academic certificates and transcripts in existing blockchain systems and focusing the need for enhanced interoperability to connect diverse academic data for more comprehensive educational outcomes.

Alsobhi et al. (2023) carried out a systematic research of Blockchain-based micro-credentialing systems inside higher education institutions (HEIs), emphasising the requirement for effective micro-credential validation. This review focused on the credentialing function of blockchains. The study outlines the goal of creating an intelligent blockchain-based micro-credential framework that will help students in higher education manage their micro-credentials, offer learning recommendations, and create a dependable worldwide system that will benefit employers, higher education institutions, and students.

The studies presented thus far provide evidence that investigating how instructors, students, and other stakeholders view the potential incorporation of blockchain technology in higher education is crucial. Moreover, it clearly indicates the importance of identifying potential obstacles to their adoption of this cutting-edge technology as well as their knowledge, worries, and perceived benefits.

RESEARCH PROBLEM, AIM, AND SCOPE

Technology is advancing at an inexorable rate in today's classroom, which necessitates a deep analysis of innovative solutions like integration of blockchain technology. The conventional approaches to maintaining academic records and verifying credentials within the academic sphere frequently exhibit vulnerabilities in terms of security breaches and operational inefficiencies. It is crucial for institutions of higher education to explore more resilient alternatives. The utilisation of blockchain technology, characterised by its decentralised and unalterable ledger system, offers a compelling resolution to tackle many issues and challenges. The comprehension of perspectives of students, educators, and other stakeholders about blockchain as of utmost importance, and their active involvement and willingness to adopt this technology are pivotal factors for the achievement of any technological advancement in the field of education.

This study focuses on gaining an understanding of perspectives to determine the extent to which blockchain technology is in line with the values and expectations of the academic community. The results of this study can provide valuable insights for educational institutions in customising their approaches to adopting technology, namely in addressing apprehensions of students and educators and capitalising on the perceived advantages of blockchain technology.

Furthermore, this study can give a basis for future research initiatives. It highlights the possibility for more investigation into the integration of blockchain technology within the higher education system. It emphasises the importance of blockchain literacy initiatives and the need to identify any barriers that may hinder its widespread implementation. Through the process of elucidating the potential and issues linked to the use of blockchain technology, this research makes a valuable contribution towards enhancing comprehension of the difficulties and opportunities that arise from the utilisation of advanced technologies in the field of education. The potential impact of the findings of this research can extend to the future of learning, credentialing, and data management in higher education.

Research Question

The primary research question that directs this investigation is:

What are the attitudes of students, instructors, and administrators about the potentials of blockchain technology in higher education, and how these perspectives are impacted by participants' demographics?

METHODOLOGY

The design of the study is a quantitative survey method. The study was conducted on the context of Saudi Arabian higher education. Due to the large distribution of the population across all Saudi universities including students at the Associate, Bachelor's, Master's, and Doctoral levels, as well as

educators and administrators, the study utilized multiple social networks sampling techniques to reach the sample. It used web panels, convenience sampling, Judgmental or purposive sampling, and snowball sampling. According to Ohei and Chukwuere (2022), applying multiple sampling techniques through social networks platform limits bias and open sampling and allows tracking and directing the data collection. Web panels sampling was used through social networks' groups while snowball used when asking for chain-referral among participants. Convenience sampling, on the other hand, used when reaching those who are registered in universities' listservs. Judgement sampling took a place when reaching those who affiliated with higher education institutions in their social network profiles. The final sample size was 509 participants and the detailed distribution of the sample is given in Table 1. The questionnaire was published through online survey system and checked for its responsiveness to multiple devices. The Scale for Evaluation of Blockchain Technology Potentials in Higher Education is the instrument utilised in this study. It has five components: Familiarity with Blockchain, Perception of Blockchain in Higher Education, Blockchain Applications in Higher Education, Readiness, and Implementation. The statistical technique used is percentage analysis, correlation and MANOVA test.

Ethical Considerations

Informed consent was obtained from all participants, ensuring they were fully aware of the study's purpose and their rights. Participants were assured of confidentiality and the anonymization of their responses.

RESULTS

Demographics

Table 1: Demographic Details of The Study Sample

Demographics		N	%
Age	18 - 28	28	5.5
	25-34	165	32.4
	35-44	267	52.5
	45- or above	49	9.6
Gender	Male	125	24.6
	Female	384	75.4
Degree	Associate degree	44	8.6
	Bachelor's degree	144	28.3
	Master's degree	281	55.2
	Doctoral degree	40	7.9
Role	Student	51	10.0
	Educator	337	66.2
	Administrator	121	23.8

The demographics of sample recruited for the investigation is described in Table 1. Participants fall into a variety of age groups; the largest age group was 35–44 (52.5%), followed by 25–34 (32.4%). In terms of gender, 75.4% were female and 24.6% were male. Educational attainment varied, with 55.2% holding a master's degree and 28.3% having a bachelor's degree. The largest group in terms of profession was educators (66.2%), followed by administrators (23.8%).

Data Analysis

Table 2: Familiarity with Blockchain

Questions		M	SD
1.	Have you heard of blockchain technology?	3.36	.73
2.	How would you rate your knowledge of blockchain technology?	2.96	.77

Table 2 shows that participants, on average, reported a moderate level of familiarity with blockchain technology, with a mean rating of 3.36 (SD = 0.73). Their self-rated knowledge of blockchain technology was also moderate, with an average rating of 2.96 (SD = 0.77).

Table 3: Perception of Blockchain in Higher Education

Questions	M	SD
3. What are the potential benefits of implementing blockchain in higher education?	3.55	.64
4. What challenges or concerns do you foresee in the adoption of blockchain in higher education?	3.29	.87
5. Do you believe blockchain can enhance the security and credibility of educational credentials?	3.15	.80

According to Table 3, participants generally thought that integrating blockchain technology into higher education will have somewhat positive effects (M = 3.55, SD = 0.64). Respondents said that they were somewhat concerned about or anticipated difficulties with the implementation of blockchain in higher education (M = 3.29, SD = 0.87). Participants also held a moderately positive belief that blockchain can enhance the security and credibility of educational credentials (M = 3.15, SD = 0.80).

Table 4: Applications of Blockchain in Higher Education

Questions	M	SD
6. How do you think blockchain can facilitate credential verification in higher education?	3.56	.65
7. What are your thoughts on the potential of blockchain in enabling decentralized learning platforms?	3.23	.84
8. Do you believe blockchain can support lifelong learning and micro-credentialing?	3.12	.87

Table 4 shows that participants, on average, perceived blockchain as having potential in facilitating credential verification in higher education (M = 3.56, SD = 0.65). They held moderate beliefs in the potential of blockchain to enable decentralized learning platforms (M = 3.23, SD = 0.84) and to support lifelong learning and micro-credentialing (M = 3.12, SD = 0.87).

Table 5: Readiness and Implementation

Questions	M	SD
9. How prepared do you think higher education institutions are for adopting blockchain technology?	3.64	.63
10. What do you see as the major barriers or challenges to implementing blockchain in higher education?	3.16	.91
11. What factors would encourage or discourage higher education institutions from adopting blockchain technology?	3.19	.77

Table-5 shows that participants, on average, perceived higher education institutions to be moderately prepared for adopting blockchain technology (M = 3.64, SD = 0.63). They recognized the presence of barriers or challenges to implementing blockchain in higher education (M = 3.16, SD = 0.91) and identified factors that could encourage or discourage adoption (M = 3.19, SD = 0.77).

Table 6: Multivariate Analysis of the Six Demographic Variables

Effect	Test	Value	F	Hypothesis df	Error df	Sig.
1. Age	Wilks' Lambda	.874	.939	27.000	535.097	.556

2. Gender		.979	.444	9.000	183.000	.910
3. Degree		.868	.982	27.000	535.097	.492
4. Role		.928	.771	18.000	366.000	.734
5. Familiarity with blockchain		.854	.820	36.000	687.523	.765
6. Knowledge of blockchain		.785	1.277	36.000	687.523	.132

Table 6 shows that no significant correlations were found between participants' demographics and their perspectives on potentials of blockchain technology in higher education ($p \geq .05$). The hypothesis that was developed to analyse the relationship was that there would be a strong correlation between the viewpoints of participants on the potential of blockchain technology in higher education and their demographics. Wilks' Lambda values for all six demographics are relatively high, ranging from 0.854 to 0.979. This shows that the demographics account for a relatively small amount of the variance in participants' perspectives. The F-values for all six demographics are relatively low, ranging from 0.444 to 1.277. The alternative hypothesis, which proposed a substantial relationship between the demographics of participants and their views on the possible applications of blockchain technology in higher education, was thus not supported. This concludes that the demographics do not have a statistically significant relation to participants' perspectives on blockchain technology.

Table 7: Correlation among different dimensions of perspectives of students on potentials of blockchain Technology

Components		**C1FB**	**C2 PBBI**	**C3 CAB**	**C4 BSC**	**C5 BCV**	**C6 BDL**	**C7 BLLM**	**C8 BIB**
C9KB	r	.214**							
	Sig.	.000							
	N	509							
C2 PBB	r	.171**							
	Sig.	.000							
	N	496							
C3CAB	r		-.095*						
	Sig.		.041						
	N		460						
C4 BSC	r	.090*		-.114*					
	Sig.	.048		.016					
	N	478		450					
C5 BCV	r	.179**	.167**						
	Sig.	.000	.000						
	N	494	483						
C6 BDL	r	.091*			.124**		-.095*		
	Sig.	.047			.008		.048		
	N	481			458		434		
C10-HP	r	.095*	.112*			.099*			
	Sig.	.035	.014			.029			
	N	494	484			481			
C8	r						.106*		

BIB	Sig.						.030		
	N						423		
C11 FAB	r	.139**			.126**			.112*	-.156**
	Sig.	.002			.007			.017	.001
	N	478			455			458	426

*Significant at 0.05 level &** Significant at 0.01 level

C-1 Familiarity of blockchain

C-2 Potential benefits of implementing blockchain

C3- Challenges to the adoption of blockchain

C4-Blockchain enhance security and credibility of credentials

C5-Blockchain facilitate credential verification

C-6 Blockchain enables decentralized learning

C7- Blockchain support lifelong learning and micro-credentialing

C8 - Barriers to implementing blockchain

C9-KB Knowledge about blockchain technology

C10 HP- Higher education preparedness

C11 FAB - Factors encourage adopting blockchain

Table 7 demonstrates that understanding of blockchain and familiarity with the technology are positively and significantly correlated ($r = 0.214$, $p < 0.001$). Familiarity with blockchain has a positive and substantial link with the anticipated potential benefits of deploying it in higher education ($r = 0.171$, $p < 0.001$). The belief that blockchain can enhance the security and credibility of credentials has a weak positive correlation with familiarity with blockchain ($r = 0.090$, $p = 0.048$). The belief that blockchain can facilitate credential verification has a positive and significant correlation with familiarity with blockchain ($r = 0.179$, $p < 0.001$). The belief that blockchain can support lifelong learning and micro-credentialing has a weak positive correlation with familiarity with blockchain ($r = 0.091$, $p = 0.047$). Higher education preparedness for adopting blockchain has a weak positive correlation with familiarity with blockchain ($r = 0.095$, $p = 0.035$). There is a positive and significant correlation between factors that encourage adopting blockchain and familiarity with blockchain ($r = 0.139$, $p = 0.002$).

Further, results demonstrates a weak negative correlation ($r = -0.095$, $p = 0.041$) between the perceived potential benefits of implementing blockchain and the obstacles to its acceptance in higher education. The belief that blockchain can facilitate credential verification has a positive and significant correlation with the perceived potential benefits of implementing blockchain ($r = 0.167$, $p < 0.001$). Higher education preparedness for adopting blockchain has a weak positive correlation with the challenges to adoption ($r = 0.112$, $p = 0.014$). There is a weak negative correlation between the challenges to the adoption of blockchain in higher education and the variable blockchain enhance security and credibility of credentials ($r = -0.114$, $p = 0.016$).

Moreover, it demonstrates that there is a strong and positive correlation ($r = 0.124$, $p = 0.008$) between the idea that blockchain supports micro-credentialing and lifelong learning and the belief that blockchain improves the security and credibility of credentials. Factors that promote blockchain adoption are positively correlated with the assumption that blockchain improves security and credential credibility ($r = 0.126$, $p = 0.007$). There is a weak positive correlation between higher

education preparedness and the belief that blockchain can facilitate credential verification ($r = 0.099$, $p = 0.029$).

It also shows that there is a weak negative correlation between the belief that blockchain enables decentralized learning and the challenges to implement blockchain in higher education ($r = - 0.095$, $p = 0.048$). There is a weak positive correlation between the belief that blockchain enables decentralized learning and the barriers to implement blockchain in higher education ($r = 0.106$, $p = 0.030$). There is a weak positive correlation between the belief that blockchain supports lifelong learning and micro-credentialing and the barriers to implementing blockchain in higher education ($r = 0.112$, $p = 0.017$). The hurdles to using blockchain in higher education are correlated with the perception that blockchain facilitates micro-credentialing and lifelong learning in a moderately unfavourable way ($r = - 0.156$, $p = 0.001$).

DISCUSSION

The findings regarding perspectives on potentials of blockchain technology shows that participants had a moderate level of familiarity and self-rated knowledge of blockchain technology. They are aware of the possible advantages of integrating blockchain technology into higher education, but they are also anticipating problems and concerns. Participants held a moderately positive perception of blockchain's ability to facilitate credential verification, enable decentralized learning platforms, and support lifelong learning and micro-credentialing. Moreover, participants expressed that higher education institutions need to have a moderate level of preparedness for adopting blockchain technology and identified various factors that could influence their decision to integrate it. These results are in line with those of Astaman & Mauritsius (2023), who discovered that students' opinions on blockchain technology are often seen favourably as they can understand how it may improve the efficiency and transparency of the educational process. They are also inconstant with Fedorova & Skobleva (2020) as they found that 50 % of university professors are unaware of the blockchain technology. This could be attributed to the maturity of this technology and its educational applications in the lest four years enhanced by COVID-19 pandemic transitions to more technology-based learning and teaching.

In this study, participants thought that using blockchain technology in higher education would have some advantages. The results align with those of Paul et al. (2022), who discovered that blockchain has promise for transforming the conventional educational system and establishing a more accessible and egalitarian learning environment. It is also in line with the findings of Palma et al. (2013), who discovered that blockchain technology can provide a safe, unhackable method for sharing and storing student credentials, increasing academic productivity, and lowering fraud. The results align with the findings of Hillman & Ganesh (2019), Casino et al. (2019), Omi et al. (2020), and Yuliana & Agustina (2022), who also discovered potential benefits of blockchain technology in higher education.

From another perspective, the study found that participant perceived blockchain as having potential applications in facilitating credential verification in higher education. The results align with those of Palma et al. (2019) and Sakhipov et al. (2022), who discovered possible uses for blockchain technology in higher education, including credentialing, student data management, governance, and more.

According to the survey, participants thought that universities were only mediocrely ready to implement blockchain technology. The results are in line with those of Palma et al. (2019), Juricic et al. (2019), Cardoso (2020), Badhe (2020), Raimundo & Rosário (2021), Bucea-Manea-Tonis et al. (2021), and other scholars who discovered that academic institutions were ready to use blockchain technology for a variety of objectives. It is inconstant with Fedorova & Skobleva (2020) as they found that only 50 % of university professors has awareness and ability to apply the blockchain technology

in higher education. Mohammad & Vargas (2022) found that there are some institutional and organisational barriers to adopt blockchain technology in higher education.

Interestingly, participants' age, gender, educational background, professional role, and levels of familiarity and knowledge related to blockchain did not play a significant role in influencing their perspectives on the factors being studied. As found by Broni and Owusu (2020), this result can be seen as reassuring for researchers and policymakers, as they suggest that the demographics of the participants are not strong determinants of their perspectives in this context. Those who are more familiar with blockchain technology tend to be more knowledgeable and aware of it, according to the result that there is a positive and substantial link between familiarity with blockchain technology and understanding of blockchain.

There is a strong and favourable relationship between knowledge with blockchain technology and the anticipated potential benefits of integrating it into higher education. This indicates that individuals who perceive greater potential benefits are more likely to be familiar with blockchain technology. The belief that blockchain can enhance the security and credibility of credentials has a weak positive correlation with familiarity with blockchain. This implies that individuals who are more familiar with blockchain technology tend to have a stronger belief in its ability to enhance security and credibility. The belief that blockchain can facilitate credential verification has a positive and significant correlation with familiarity with blockchain. This suggests that individuals who are more familiar with blockchain technology are more likely to believe in its potential for facilitating credential verification.

The belief that blockchain can support lifelong learning and micro-credentialing has a weak positive correlation with familiarity with blockchain. This shows that individuals who are more familiar with blockchain technology are more likely to believe in its potential for supporting lifelong learning and micro-credentialing. Higher education preparedness for adopting blockchain has a weak positive correlation with familiarity with blockchain. This indicates that individuals who are more familiar with blockchain technology perceive higher education institutions to be more prepared for adopting it. Familiarity with blockchain and factors that promote its adoption are positively and significantly correlated. This implies that individuals who are more familiar with blockchain technology are more likely to perceive factors that encourage its adoption.

The anticipated potential advantages of deploying blockchain technology are inversely correlated with the obstacles to its acceptance in higher education. This suggests that as the challenges to adoption increase, the perceived potential benefits decrease. The belief that blockchain can facilitate credential verification has a positive and significant correlation with the perceived potential benefits of implementing blockchain. This shows that as the perceived potential benefits increase, the belief in the facilitation of credential verification also increases.

Higher education preparedness for adopting blockchain has a weak positive correlation with the challenges to adoption. This shows that as higher education institutions perceive themselves to be more prepared for adopting blockchain, they also tend to recognize more challenges to its adoption. The variable "blockchain increase security and credibility of credentials" exhibits a modest negative connection with the obstacles to blockchain use in higher education. This indicates that as the challenges to adoption increase, the belief in the enhancement of security and credibility of credentials through blockchain decreases.

The perception that blockchain improves credentials' security and credibility and the perception that blockchain supports micro-credentialing and lifelong learning are positively and significantly correlated. This indicates that individuals who believe that blockchain enhances security and credibility of credentials are also more likely to believe in its potential for supporting lifelong learning and micro-credentialing. The notion that blockchain improves security and credential credibility is

positively and significantly correlated with elements that promote blockchain adoption. This shows that individuals who believe in the security and credibility enhancement of credentials through blockchain are also more likely to perceive factors that encourage the adoption of blockchain. There is a weak positive correlation between higher education preparedness and the belief that blockchain can facilitate credential verification. This suggests that as higher education institutions perceive themselves to be more prepared for adopting blockchain, they are also more likely to believe in the facilitation of credential verification through blockchain.

There is a weak negative correlation between the belief that blockchain enables decentralized learning and the challenges to implement blockchain in higher education. This indicates that as the challenges to implementing blockchain increase, the belief in blockchain's ability to enable decentralized learning decreases. There is a weak positive correlation between the belief that blockchain enables decentralized learning and the barriers to implement blockchain in higher education. This indicates that as the barriers to implementing blockchain increase, the belief in blockchain's ability to enable decentralized learning also increases.

The perception that blockchain technology facilitates micro-credentialing and lifelong learning is positively correlated, if weakly, with the obstacles to its use in higher education. This shows that as the perceived barriers to implementing blockchain increase, the belief in blockchain's ability to support lifelong learning and micro-credentialing also increases. The hurdles to deploying blockchain in higher education are somewhat correlated with the assumption that blockchain enables micro-credentialing and lifelong learning. This indicates that as the barriers to implementing blockchain increase, the belief in blockchain's ability to support lifelong learning and micro-credentialing decreases. The correlation is statistically significant.

CONCLUSIONS

The primary outcome of the study reveals that the students, educators, and administrators possess a reasonable degree of familiarity and self-assessed understanding of blockchain technology. The participants are informed about the possible advantages of blockchain technology for higher education. These benefits include credential verification, the use of decentralised learning environments, support for lifelong learning, and the deployment of micro-credentialing systems.

The primary implication of the study is that it emphasises the necessity for educational institutions to contemplate the incorporation of blockchain technology as a prospective remedy for diverse challenges encountered in higher education. These challenges represent bolstering the security of credentials, facilitating lifelong learning, and resolving concerns pertaining to academic deception and payment verification. Furthermore, it stresses the significance of effectively addressing the challenges that students encounter in comprehending blockchain technology. This highlights the necessity for initiatives focused on enhancing blockchain education and fostering digital literacy among pupils. It is vital for institutions of higher education to allocate resources towards programmes aimed at enhancing awareness and knowledge pertaining to blockchain technology. This deliberate commitment is essential to providing students with the knowledge and abilities needed to engage effectively in the application of this quickly developing innovation.

Also, the study highlights a connection between the belief in blockchain technology's potential benefits and the perceived challenges of using it. This observation implies a comprehensive and subtle strategy is required to properly tackle these concerns and advance the adoption of the technology. According to the study, it would be advantageous for universities to devote funds to implementing blockchain technology and creating curricula that would improve students' comprehension and competency with blockchain ideas. Improving students' understanding of blockchain and resolving their concerns can promote a more smooth adoption of this technology in the context of higher education. In order to enhance the scope of future investigations, it is crucial for

researchers to undertake an exploration of additional variables that could potentially impact students' perspectives on blockchain. These variables could consist of prior exposure to blockchain applications, individual interests, and cultural influences. Furthermore, the utilisation of longitudinal research may provide valuable insights into the evolving attitudes of students as blockchain technology becomes increasingly pervasive in higher education.

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