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Bridging Innovation and Security: A Bibliometric Review of Blockchain's Impact on Higher Educational Institution Management

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Abstract

Blockchain technology in higher education institutions (HEIs) can revolutionize academic administration by improving data security, increasing transparency, and boosting operational efficiency. However, blockchain adoption in HEIs faces technological, organizational, and regulatory challenges. A bibliometric review procedure assessed the 246 relevant studies from Scopus peer-reviewed literature on blockchain adoption's main themes, most prominent authors, journals, and articles. The findings highlight Blockchain's ability to streamline credential verification, automate academic processes, and reduce administrative costs. However, key barriers such as scalability limitations, interoperability issues, financial constraints, and regulatory challenges continue to hinder widespread implementation. Besides, there is a significant gap in top management support and institutional readiness, which impacts the integration of blockchain systems in educational frameworks. This study advances the scholarly discourse on blockchain implementation in academia by examining the challenges associated with its adoption and proposing strategic solutions to facilitate its effective integration. The research implies compelling insights for policymakers, educational leaders, and technology developers eager to capitalize on the revolutionary opportunities of blockchain technology in HEIs. Besides, this study is among the first to demonstrate a structured analysis of Blockchain's impact on operational efficiency in HEIs from a

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technological, organizational, and environmental perspective, addressing the gap in institutional readiness.

Keywords: Blockchain Adoption, Higher Education Institutions, Digital Credentials, Academic Administration, Adoption Challenges, Data Security

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1.0 Introduction

Contemporary higher educational institutions are concerned with the growing aggressiveness, challenge, and prominence of global educational learning experiences (Austin & Jones, 2024), with the ever-changing technology adoption (Kayyali, 2024). Blockchain Technology is an evolving concept in higher education research in sustaining institutional competitive advantages. The shift to digital platforms for administrative management, teaching, and learning reshapes how institutions operate and interact with students, faculty, and external stakeholders (Singun, 2025). This global trend underscores the growing demand for innovative technological solutions to meet the evolving needs of the education sector (Samala et al., 2024; Seong et al., 2022). Besides, adopting blockchain technology in educational approaches should be emphasized to improve the technological orientation of higher education institutions (HEIs). Blockchain technology is one of the green technologies (Polas et al., 2022), mainly correlated to the fourth industrial revolution, which is significantly pivotal to sustaining competitive advantage in HEIs. Despite the potential technologies being used in education, Blockchain appears to be a winner (Marouan et al., 2024). Blockchain was designed for cryptocurrencies. However, its characteristics, like transparency, decentralisation, and enhanced security, can considerably help the administrative and academic operations of HEIs. A blockchain-based platform will help verify students' credentials, keep their records, and securely share this data. While Blockchain has great promise in HEIs, the uptake has been slow and uneven.

Blockchain technology's implementation in academia is much less than the potential it holds to improve the operational efficiency and effectiveness of HEIs and relevant stakeholders. Numerous studies have been completed on how Blockchain could assist education (Capece et al., 2020; Capetillo et al., 2022; Kosmarski, 2020). However, these studies tend to focus only on certain technologies or cases. Furthermore, there aren't many frameworks that discourage the integration of Blockchain in HEIs. This is due to technological, organisational, and environmental barriers. Despite its potential, the challenges and factors influencing the adoption of Blockchain in HEIs are very limited. Previous studies are often siloed (Austin & Jones, 2024; Chen et al., 2018; Schwarzer et al., 2022) and fail to provide unified concepts. This stliteratureill this gap

in the literature by conducting a bibliometric analysis of academic articles and providing insights to policymakers, academicians and technology developers to understand this technology. The literature on Blockchain's impact on HEIs has been reviewed from 2017 to 2025, aiming to address the following research questions:

a) What are the current research trends for Blockchain's impact on HEIs?
b) How is the execution of Blockchain in HEIs conducted?
c) What discernible gaps and challenges exist within the research field?

2.0 Blockchain Technology

The development of Bitcoin by Satoshi Nakamoto in 2009 caused the emergence of blockchain technology (Mansoori & Maheshwari, 2022). The concept of Blockchain initially appeared in the financial sector with the distributed Bitcoin data transaction structure based on peer-to-peer networks (Marsal-Llacuna, 2018). In a broader context, blockchain technology demonstrated a connected database in a highly secure platform or distributed ledger where value (in the form of bonds, stocks, money, deeds, intellectual properties, votes, or even music) can be exchanged and stored without prevailing intermediaries. Promoting blockchain technology in HEIS is crucial to automate and democratise the educational learning process and reduce bureaucracy costs. (Haugsbakken & Langseth, 2019). However, limited reviews have offered a holistic retrospective on blockchain adoption in HEIs (Chen et al., 2018; Dwivedi & Vig, 2024).

2.1 Benefits of Blockchain Technology Adoption

The adoption of blockchain technology in higher education has been praised for its potential to bring significant technological, organisational, and societal benefits (Capece et al., 2020; Mohammad & Vargas, 2022; Sharif & Ghodoosi, 2022). However, the extent to which these benefits have been realised varies across studies (Alammary et al., 2019; De Alwis et al., 2025; Pondkule & Kothari, 2025). Blockchain is secure and transparent, as mentioned in the literature by Abdullah et al. (2024), Nazari et al. (2024), and Rani et al. (2024). Various studies claimed that Blockchain is a solution to fraud in the academic

certification system (Marouan et al., 2024; Zakaria et al., 2021). The researchers view it as a tamper-proof way of issuing and verifying these certifications. However, concerns persist about scalability. In addition, Alammary et al. (2019) suggest that while Blockchain enhances security, it cannot handle the huge volume of transactions necessary in educational systems. This contradiction somewhat exposes the need for more empirical research on scalability in real-world educational contexts.

The HEIs could build resilience in the educational system through blockchain technology (Bai et al., 2024). According to past research, Blockchain eases administrative tasks such as confirming transcripts and reduces the number of intermediaries (Purusottama & Trilaksono, 2024). Nevertheless, in the past literature, institutional resistance to change is a major barrier to realising these benefits (Khuc et al., 2024). This highlights the difficulties of implementing new technologies in legacy systems and shows that organisational readiness should be taken into account in future studies on blockchain use. From a societal perspective, Blockchain could gain trust in academic qualifications from a global viewpoint (Ramasamy & Khan, 2024). Credentials anchored on Blockchain can facilitate the verification of qualifications by employers, leading to increased mobility of students and professionals in the world (Gurzhii et al., 2025). However, societal acceptance of Blockchain remains low. Moreover, there has been limited existing research concerned with blockchain technology in the education sector (Satvik et al., 2025). Future studies might explore how different cultures affect the uptake of blockchain-based credentials.

2.2 Barriers to Blockchain Technology Adoption in Higher Education Institutions

Higher education institutions are not extensively implementing blockchain technology despite the benefits of blockchain-based systems. Thus, it is crucial to understand the factors that obstruct HEIs from integrating blockchain-based systems in their institutions. Blockchain adoption challenges in HEIs could be classified into three frameworks: technology, organisations, and environment. Challenges in the technological framework include: (1) primitive technology, (2) integration complexity, (3) immutability and lack

of flexibility, (4) lack of scalability, (5) limited interoperability, (6) poor usability, (7) privacy, (8) security issues, and (9) inaccessibility. From the perspective of the management approach, there is (10) a deficiency of competent skills, (11) insufficient top management support and (12) financial barriers. The environmental challenges include (13) market and ecosystem readiness, (14) legal issues and lack of regulatory compliance, and (15) sustainability concerns. Similarly, Figure 1 indicates the breakdown of challenges into groups based on technology, organisations, and the environmental framework.

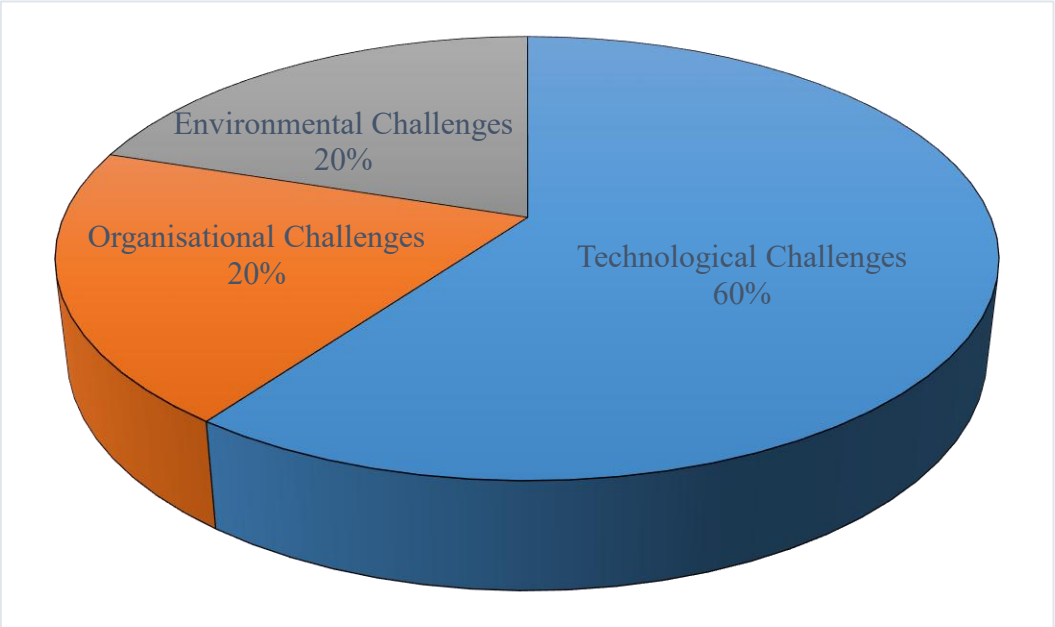

Figure 1: Breakdown of the Challenges Based on Technological, Organisational, and Environmental Framework (Mohammad & Vargas, 2022)

The complexity of blockchain technology and the lack of technical expertise in higher education institutions have been frequently mentioned as significant barriers (Satvik et al., 2025). Blockchain's integration with existing IT infrastructure is also seen as a challenge (Koukaras et al., 2024). In comparison, many studies agree on the importance of technical training for staff (Celik et al., 2024; Kontzinos et al., 2024). Some argue that the initial costs and maintenance of blockchain systems remain

prohibitive for smaller institutions (Di Prisco & Strangio, 2025). These issues show that universities need to invest in education technology and human resources to counter these technological problems.

One of the clear barriers is institutional resistance to change (Singun, 2025). This refers to the unwillingness of faculty and staff to adopt new systems, and it also disrupts the current administration (Naik et al., 2024). The authority of people has important effects on the organisational-cultural adoption or resistance, while according to others, the organisational culture plays a role in this regard (Abdelwahed et al., 2025; Ghafoori et al., 2024). Researching how institutional culture and leadership style affect blockchain implementation (Risius & Benedict, 2024) can help future studies. According to Silaghi & Popescu (2025), there is a lack of regulations regarding using Blockchain in higher education. An example is data privacy and compliance with educational standards (Mustafa et al., 2025). Despite mentioning the General Data Protection Regulation (GDPR) as a barrier to blockchain adoption in Europe, some scholars argue that regulations will slowly be advanced to accommodate Blockchain (Zhang et al., 2024). As such, there is a need for policy development literature to explore how regulatory bodies can facilitate blockchain adoption.

3.0 Methodology

This research explores how blockchain technology is adopted by higher education institutions (HEIs). As per the guidelines of Budgen & Brereton (2006) and Mohamed Shaffril et al. (2021), a systematic assessment of academic literature was employed to analyse publication trends, citation patterns, research output, and collaboration networks. The method searches literature, exploring the various themes, authors, journals, and related research gaps to help provide an objective and number-based understanding of blockchain adoption in HEIs as it exists in contemporary literature.

3.1 Inclusion and Exclusion Criteria

The subsequent inclusion and exclusion criteria were implemented to ascertain the relevance and quality of the chosen investigations, as delineated in Table 1.

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Empirical studies, case studies, systematic reviews, and theoretical frameworks on Blockchain in HEIs.	Studies not related to Blockchain or higher education.
English-language peer-reviewed journal articles and conference papers.	The articles that were not peer-reviewed or in the English language were excluded.
Studies published between the years 2000 and 28 February 2025.	Studies that were published before 2000, unless are seminal works.
Research interests include "blockchain in HEIs", "challenges of blockchain in HEIs", and "domains of blockchain in HEIs".	Book chapters, conference proceedings, or dissertations that are not aligned with the research aims and objectives.

3.2 Search Strategy

The search strategy follows a systematic and replicable process to identify relevant studies comprehensively. The search was conducted using the Scopus database due to its extensive coverage of peer-reviewed literature. The following search string was used:

TITLE-ABS-KEY ("Education" AND "Blockchain") AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (SRCTYPE, "j"))

Next, the flow diagram is outlined to identify, screen, and select the relevant literature. This transparent process ensures the study's replicability and reliability, which is essential for systematic literature reviews (Zakaria et al., 2021). The search process involved multiple stages, including identification, screening, eligibility, and final

inclusion of articles. The initial search yielded 765 articles. Next, these articles are evaluated based on each study's methodological rigour, reliability, and relevance, providing insights into any potential biases or weaknesses in the studies included in the analysis. After removing duplicates and going through each article, 510 articles were selected for the bibliometric analysis, as shown in Figure 2.

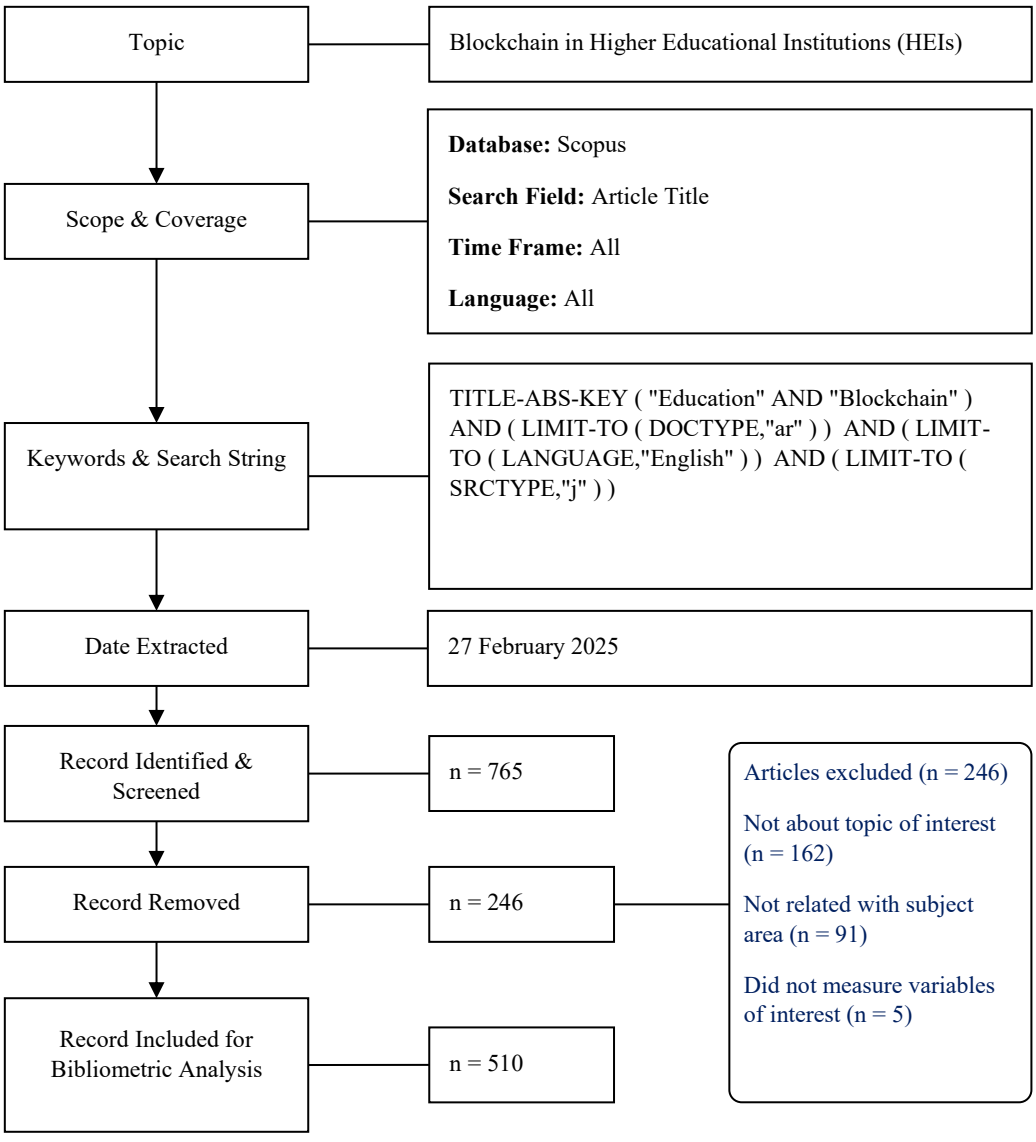

Figure 2: Flow Diagram of the Search Strategy(Zakaria et al., 2021)

3.3 Data Extraction and Synthesis

The data was programmed and analyzed using information from the Scopus database to identify patterns, gaps, and connections in using Blockchain in higher education institutions (HEIs). A co-occurrence network was created using VOS viewer to visualise the interrelatedness of the various terms and concepts associated with Blockchain in HEIs (Van Eck & Waltman, 2010). The co-occurrence network illustrates the important research areas and theme clusters on blockchain adoption in HEIs. By mapping the co-occurrence of keywords, various concepts are interconnected, and areas that are gaining scholarly attention are identified. This visualisation offers valuable insights into how technological, organisational, and environmental factors influence blockchain adoption in HEIs (Ankrah & Al-Tabbaa, 2015).

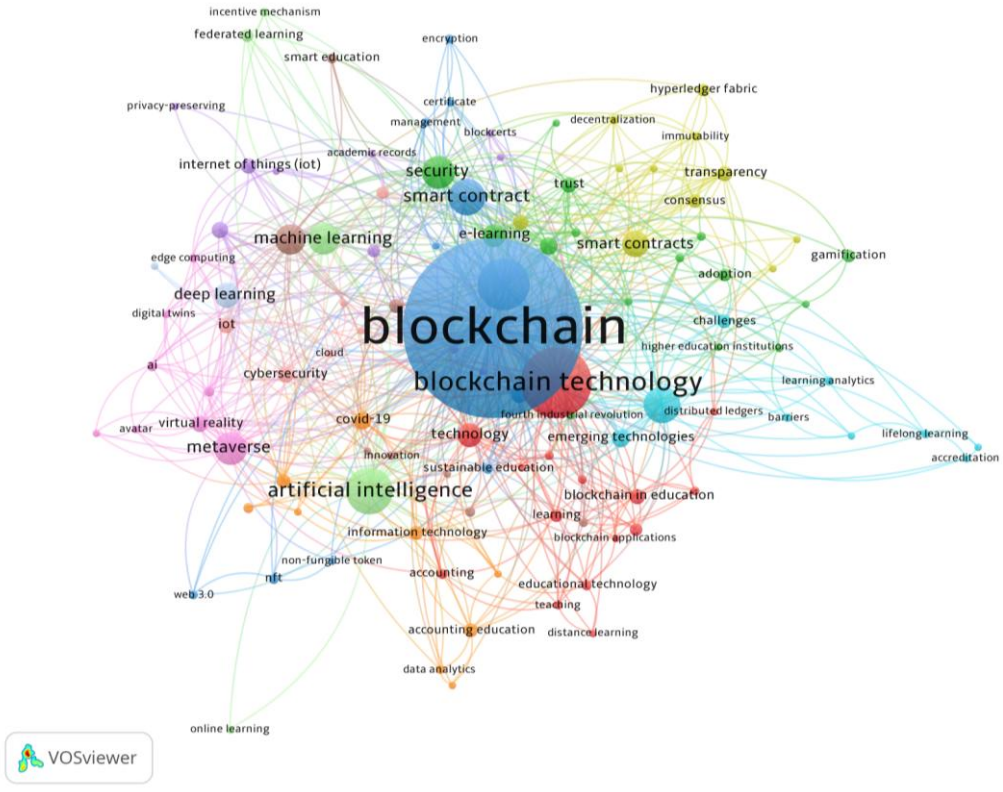

Figure 3: Co-occurrence Network of Blockchain in Higher Education Institutions

4.0 Discussion and Future Directions

A rising emphasis on organisational frameworks and environmental impact assessments in sustainability may impede blockchain technology implementation in higher education institutions. This study aimed to explore (1) the major themes in blockchain adoption within HEIs, (2) the benefits and barriers perceived in the literature, and (3) the conceptual gaps to be addressed in future studies. The bibliometric findings and thematic synthesis provide insights into each of these objectives. The analysis revealed three major themes: (i) blockchain's perceived benefits in credential verification and transparency; (ii) the institutional challenges, such as resistance to innovation and lack of infrastructure; and (iii) regulatory uncertainty as a significant barrier.

More and more people recognise the fact that blockchain technology can deliver trust and transparency in credentialing. Its immutable and decentralised nature allows for secure issuance and verification of academic credentials, professional certifications, and competency records, which are globally accessible and difficult to forge (Park & Li, 2021). These features address widespread issues such as degree fraud and inefficient verification processes in cross-border education systems. The bibliometric analysis consistently emphasised these functional advantages across multiple studies. For instance, blockchain-based credentialing systems can streamline administrative tasks, increase efficiency, and foster institutional accountability. While these benefits are well documented, their real-world application remains limited, often confined to pilot projects. Therefore, future studies should investigate the longitudinal impacts of credentialing solutions and explore adoption metrics post-implementation in diverse HEI settings.

Despite the functional appeal of blockchain technology, institutional readiness proved to be a major barrier. One critical problem is the insufficient support of senior management, infrastructure, and digital literacy of personnel (Rejeb et al., 2022). Often, institutional resistance happens because of a lack of comfort with the new solution. This is especially so if its implementation will involve significant changes to processes and ways of thinking in the organisation. System integration and usability were also points of concern. Difficulties involving technical complexity, low interoperability with

existing systems, and inadequate user experience reduce stakeholders' engagement (Gabrielli et al., 2022; Kosmarski, 2020). The high initial costs, including those for infrastructure, skilled personnel, and training, deter adoption, especially in institutions with budget constraints (Delgado-von-Eitzen et al., 2021). To overcome these technical issues, HEIs should implement a phased approach to adopting blockchain solutions, use user-centred design in system development, and form strategic partnerships with a blockchain solution provider. An institutional change management framework may smooth the system transitions.

Legal and regulatory ambiguities greatly resist the adoption of Blockchain in HEIs. The lack of laws that comply with data protection laws, such as the Personal Data Protection Act (PDPA) 2012 of Malaysia, is causing increased concern about privacy violations, especially in the case of student data (Liang & Ji, 2022). Institutions struggle to define what data should remain on-chain versus off-chain and how to maintain compliance across jurisdictions. Furthermore, cybersecurity threats—such as Eclipse attacks—undermine stakeholder trust in Blockchain's security despite its perceived robustness (Guo & Yu, 2022). The lack of standardised protocols and centralised regulatory oversight amplifies this uncertainty. The bibliometric findings suggest a strong need for sector-specific legal frameworks and international standards to support secure, lawful, and scalable blockchain implementation in education. Moreover, research should further explore how legal risk perception interacts with organisational decision-making in HEIs.

5.0 Results

This section provides the systematic review results regarding article distribution, journal sources, and world output on the adoption of Blockchain in the higher education system. According to the research results, there are some gaps in knowledge. Moreover, some topics can come in handy for adopting and using Blockchain in higher education institutions.

5.1 Distribution of Articles Based on Published Year

A look at the distribution of articles over the years shows that academic interest in blockchain adoption in higher education is on the rise. As shown in Figure 4, the number of publications has steadily increased from 2017 (x-axis = 1) to 2025 (x-axis = 9), peaking between 2021 and 2024. This trend aligns with the rising popularity of blockchain technology for managing academic operations and enhancing overall institutional efficiency."

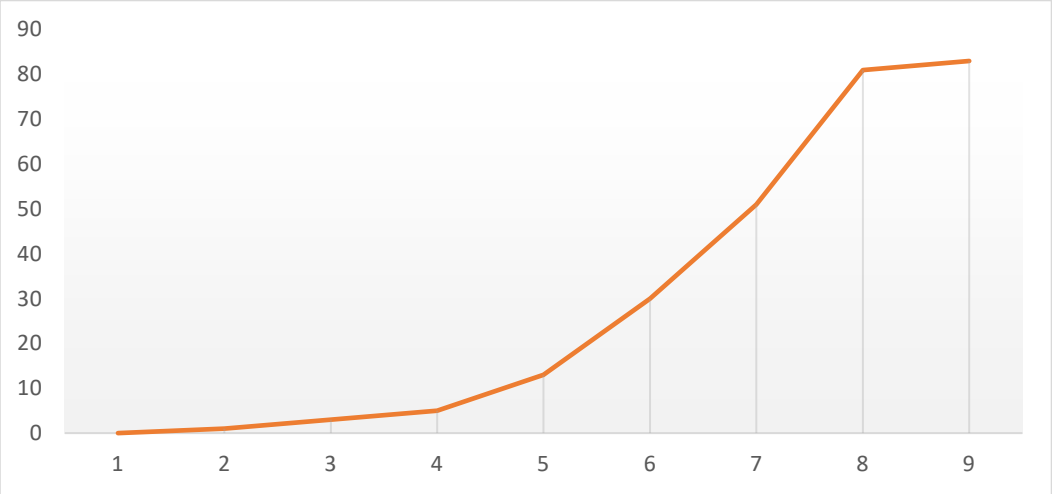

Figure 4: Distribution of Articles based on Published Year

The increase in publishing activity shows that blockchain research has shifted from being a niche area to a mainstream research topic in the field of education. There is an increasing focus on researchers and practitioners on what Blockchain can do to enhance data security, validate credentials, and ensure integrity in HEIs (Zakaria et al., 2021). The results align with broader technological trends that we have been observing in higher education, which refers basically to the effective adoption of digital technologies for the improvement of administrative efficiency and academic transparency (Baleeiro Passos et al., 2023). The growth of publications, more generally, is also a regulatorily induced requirement to manage the need for a secure and transparent system that manages access to academic records and student credentials.

5.2 Journals Published

The systematic review identified a diverse range of journals publishing research on blockchain adoption in HEIs. As shown in Table 2, the most frequent sources include IEEE Access (26 articles), Sustainability (Switzerland) (22 articles), and Education and Information Technologies (15 articles).

Table 2: Journals Published

Sources	Articles
IEEE Access	26
Sustainability (Switzerland)	22
Education and Information Technologies	15
Applied Mathematics and Nonlinear Sciences	10
International Journal of Advanced Computer Science and Applications	9
Journal Of Advanced Research in Dynamical and Control Systems	8
Computational Intelligence and Neuroscience	6
International Journal of Emerging Technologies in Learning	6
APTISI Transactions on Technopreneurship	5
Journal Of Emerging Technologies in Accounting	5

IEEE Access and Sustainability (Switzerland) gained importance because blockchain research is happening in computer science, management, and educational technology disciplines. Researchers have suggested that blockchain adoption in higher education is not limited to the technology dimension but also spans the organisational and environmental dimensions (Ankrah & Al-Tabbaa, 2015). Journal articles present extensive discussions on how the adoption of Blockchain in higher educational institutions (HEIs) affects technology, management, and policy developments. Many applications by students and enterprises in HEIs have developed this technology. The number of articles highlights ever-increasing blockchain adoption studies regarding the technical and managerial challenges of HEIs (Zakaria et al., 2021).

5.3 Worldwide Scientific Production Indexed by Scopus

The geographic spread of blockchain research in higher education institutions shows how wide and deep the impact of this technology is. The scientific output in the Scopus distribution by geographic region is illustrated in Figure 5, where the major contributors are North America, Europe, and East Asia.

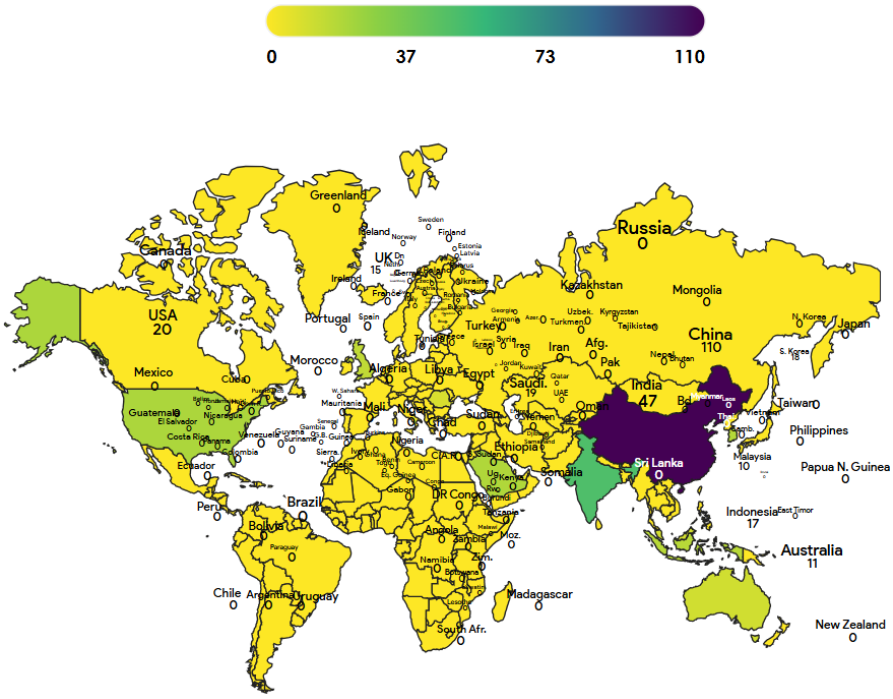

Figure 5: Worldwide Scientific Production Indexed by Scopus on Blockchain in Higher Education Institutions

According to Mohammad & Vargas (2022), the United States, China, and the United Kingdom are the world's most concentrated research activity countries due to their strong technological infrastructure and institutional support. Due to the strategic national focus on technological innovation and smart education systems, Singapore, South Korea, and Japan are becoming important centres for blockchain research in higher education (Rejeb et al., 2022). The global distribution of research indicates that blockchain adoption in HEIs is influenced by:

a) Regulatory frameworks – Countries with clear regulations on data privacy and digital infrastructure show higher adoption rates.
b) Institutional support – Research funding and industry partnerships have played a key role in accelerating blockchain adoption.
c) Technological infrastructure – Countries with advanced digital ecosystems and internet penetration levels are more likely to integrate Blockchain in HEIs.

The result of this study is compatible with those of previous studies, which noted that blockchain adoption in HEIs is a function of technological, organisational, and environmental factors (Baleeiro Passos et al., 2023). Across the world, HEIs are increasingly collaborating with technology companies to ensure better use of Blockchain, which tends to become a strategic tool to enhance the credibility of an academic and the efficiency of the operations.

6.0 Conclusion

A bibliometric analysis was conducted to assess the acceptance of Blockchain in higher education institutions. The goal was also to identify the key themes, benefits, challenges, and gaps in the literature. The study findings offer useful insights that help us understand the potential and barriers of Blockchain in HEI settings, thereby contributing to the body of knowledge in the field. The bibliometric review showed that Blockchain is a crucial technology that enhances institutional transparency and credential verification. Past research cites the technology's capacity to produce secure, immutable records that could solve long-running academic credentials, fraud, and inefficiency issues. However, despite these associated benefits, widespread adoption is limited owing to implementation barriers. A common element in the literature relates to institutional issues that block the adoption of blockchain technology: resistance to innovation and lack of infrastructure. The barriers were overcome by leadership commitment, technology readiness, and user involvement. Also, usability issues and integrating Blockchain with current institutional systems were identified as key adoption success factors. The study found that regulatory uncertainty is a major barrier to blockchain adoption in HEIs. Reiterating concerns on compliance with international data privacy laws, particularly the

General Data Protection Regulation (GDPR), and national frameworks, including Malaysia's Personal Data Protection Act (PDPA), the absence of clear laws to protect data was raised as a worry. The implementation of blockchain-based solutions in HEIs faces hurdles due to the lack of standardised protocols and legal clarity.

The bibliometric analysis showed a gap in the literature that can be targeted for further study. There is a need to examine how using Blockchain in institutions will impact them in the long term. Moreover, more studies are required to investigate blockchain adoption's legal and ethical challenges, especially related to privacy, data protection, and governance frameworks. Future research should also focus on global case studies and the scalability of blockchain solutions in various HEIs to provide practical insights for policymakers and institutional leaders. To sum up, HEIs can be transformed by blockchain technology in many ways, but there remain several technological, institutional, and regulatory challenges. This bibliometric evaluation offers excellent information on current research into Blockchain in education. Researchers, policymakers, and practitioners are increasingly interested in implementing blockchains in higher education institutions.

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