

A Bibliometric Analysis on Block-chain in Online Games

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Abstract

The investigation into blockchain technology has garnered significant attention since 2008, coinciding with the rise of Bitcoin. The primary sectors that have embraced blockchain technologies are supply chain management, healthcare, asset trading, and gaming. Online games are advanced, interconnected, multimedia and multimodal technologies on the Internet that provide enjoyable, simultaneous, lasting, and social virtual worlds for gamers. The landscape of online gaming has transformed over time, encompassing scalable cross-platform games, cloud gaming, immersive virtual reality (VR) and augmented reality (AR) games, and embracing various revenue strategies. The present study examines the existing literature through bibliometric analysis on the utilisation of blockchain technology in online gaming. The investigation reveals a scarcity of published academic articles that have examined the utilisation of blockchain technology in online games. Furthermore, the primary themes of current research encompass security, ethereum, smart contracts, and non-fungible tokens.

Keywords: Online gaming; blockchain; Bibliometric analysis

Introduction

Online games are advanced internet technologies that create interactive virtual worlds for gamers. These games are extremely sophisticated, networked, and include multimedia and multimodal features. They provide entertainment, allow simultaneous gameplay, have a persistent nature, and facilitate social interactions among players (Freeman, 2018). Games can be played on various platforms such as smartphones, tablets, personal computers, or consoles. Currently, playing online games is the second most prevalent pastime among internet users worldwide (Lenhart, 2008). Multiplayer Online Games are a rapidly growing industry, projected to reach a market volume of USD 26.29 billion with a compound annual growth rate (CAGR) of 6.6% between 2022 and 2026 (Clement, 2022). Instances of cybercrimes, such as theft and fraud, which are predominantly carried out from cafes using methods like identity theft and social engineering, have seen a surge in correlation with the growth of online gaming (Chen et al., 2005). The automated nature of these crimes enables the offender to commit numerous offences simultaneously, occurring in an online environment where the exchange of information makes identity, crime scenes, and physical evidence irrelevant (McMullan and Rege, 2010).

Blockchain is a decentralised digital database or ledger that is distributed among the nodes of a peer-to-peer network. Since 2008, the importance and popularity of blockchain technology have grown, as it is based on the decentralised public transaction record of bitcoin. Bitcoin serves as the universal unit of measurement for all transactions within the blockchain, making it unaffected by local or national currencies and having worldwide applicability (Gao and Li, 2021). The primary sectors that can implement blockchain technology include supply chain management, healthcare, asset trading, and gaming. By incorporating blockchain technology into gaming, various benefits are provided to gamers, such as the ability to make in-game items non-fungible, exchangeable, inheritable, and autonomous from the game service provider (Min et.al., 2019). Given the novelty of blockchain technology in the realm of online gaming, there is a dearth of comprehensive assessment regarding its influence. In light of this, the present study aims to address this gap by investigating the research trajectory pertaining to blockchain technology and its effects on online gaming. Bibliometric analysis can offer qualitative insights by examining and analysing scientific databases to reveal growing patterns in the relevant subject (Donthu et.al., 2021). The paper's research purpose is as follows:

1. Examine the correlation between blockchain technology and online gaming utilising the currently accessible materials in Scopus as of 2023.
2. Identify the primary countries that have made significant contributions to literature.

3. Analysing the authors who are pertinent.
4. To understand the relevant concepts presented in the analysis.

Literature Review

According to Risius and Spohrer (2017), the term "blockchain" refers to a "completely distributed system for cryptographically capturing and maintaining a consistent, immutable, linear event, log of transactions between networked entities. Block technology was originally a component of bitcoin, however it is now heavily utilised in Fintech (Ali et al., 2014) while the marketing application of blockchain technology is still at its infancy (Peres et.al., 2023). As a technology for authentication and verification as well as enabling the exchange of values and ownership in a formerly distrustful environment, blockchain is more decentralised in nature than the traditional client-server architecture, allowing parties in the digital ecosystem to transact without the aid of third parties or centralized institutions (Tan and Saraniemi, 2022). The major features of blockchain is that it is decentralized, peer-to-peer, secure, immutable, tokenizable, public, pseudonymous and open-source logging (Peres et.al., 2022). The blocks enables storage of tokens, digital assets, which can be a digital coin, an image, a vote or a license of ownership of a song (Pere et.al., 2022). Even with these benefits, the proliferation of blockchain technology to other fields has been delayed due to a lack of applications and numerous initial coin offering (ICO) frauds; online games are likely to be the technology's saving grace in this situation (Min et al., 2019).

Online games are networked multimedia usually having client server architecture (Freeman, 2018). The online games and blockchain technology becomes a good fit as there isn't data entry pollution in the digital games, as seen with other fields, the items owned by the players are non-fungible, exchangeable, inheritable, and independent to the game service provider (Min et.al, 2019). The literature related to integration of blockchain technology in online gaming is limited. Major studies are in the area of asset tokens and smart contracts (Boroń and Kobusińska, 2021; Patel et.al., 2021; Paajala et.al., 2022; Rakkini et.al., 2022; Alefs et.al., 2022), secure transactions using NFTs (Paduraru et.al., 2022; Thenjono et.al., 2022; Karapapas et.al., 2022) social practice within online games (Lin et.al., 2022;) data transparency (Yfantis and Ntalianis, 2022), decentralization (Muthe et.al., 2020; Seng et.al., 2020; Predescu et.al., 2021; Moore et.al., 2022; Pradana et.al, 2022), transactions using cryptocurrency (Zhao et.al., 2020; da Silva et.al., 2021; Liu et.al., 2021; Tekiner et.al., 2021), value exchange (Patrickson, 2021, Serada et.al., 2021), monetization in games (Pittaras et.al., 2021), 6G (Bhattacharya et.al., 2021), and serverless gaming (Wu et.al., 2020). As is clear from the literature, there are still many unresolved challenges surrounding the integration of blockchain technology into digital games, including privacy and security concerns.

Research methodology

The primary objective of the paper is evaluate the existing literature of blockchain in online games, therefore bibliometric analysis is carried out. This form of study is a systematic analytical technique that aids in identifying the most significant academics, their associations, the keywords they select, and, more importantly, the connections between academic works (Rejeb et.al., 2020).

Year	Articles
2017	2
2018	2
2019	7
2020	9
2021	11
2022	13

Fig. 1. Year-wise distribution of Blockchain literature in the field of Online Games

Data Collection

For the bibliometric analysis data from Scopus was extracted. Scopus is a renowned scientific database with a vast amount of publications, including journals from international publishers like Elsevier, Springer, Taylor & Francis, EmeraldInsight, and IEEE (Rejeb et.al., 2020). Scopus is well known for its extensive, trustworthy content. The search string used was the following: ("blockchain") AND ("gaming"). The search was performed in the title, abstract and keywords fields. The different subject areas considered were Computer Science; Business, Management and Accounting; and Social Sciences.

Conference papers and journal articles have been included in the analysis because there is a dearth of literature in the field. Initially the search query returned with 94 documents. 44 documents were selected for the final analysis using bibliometric tools RStudio and VOSviewer after the authors filtered the data by evaluating the titles and abstracts of these papers for relevance. These are open source computer programmes that were created for producing, visualising, and analysing data to produce a network of keywords that appear frequently and other pertinent data.

Descriptive Statistics

The primary study goal of the paper is to better understand how blockchain technology and online gaming relate to one another through the body of current literature. Fig. 1 shows the distribution of publications published in the field from its inception, showing a steady rise in the number of articles published over time. The top publications for works on blockchain and gaming are shown in Fig. 2. These sources have produced articles that show the diversity and multidisciplinary use of blockchain in gaming. IEEE access has the most number of published works followed by ACM conference proceedings.

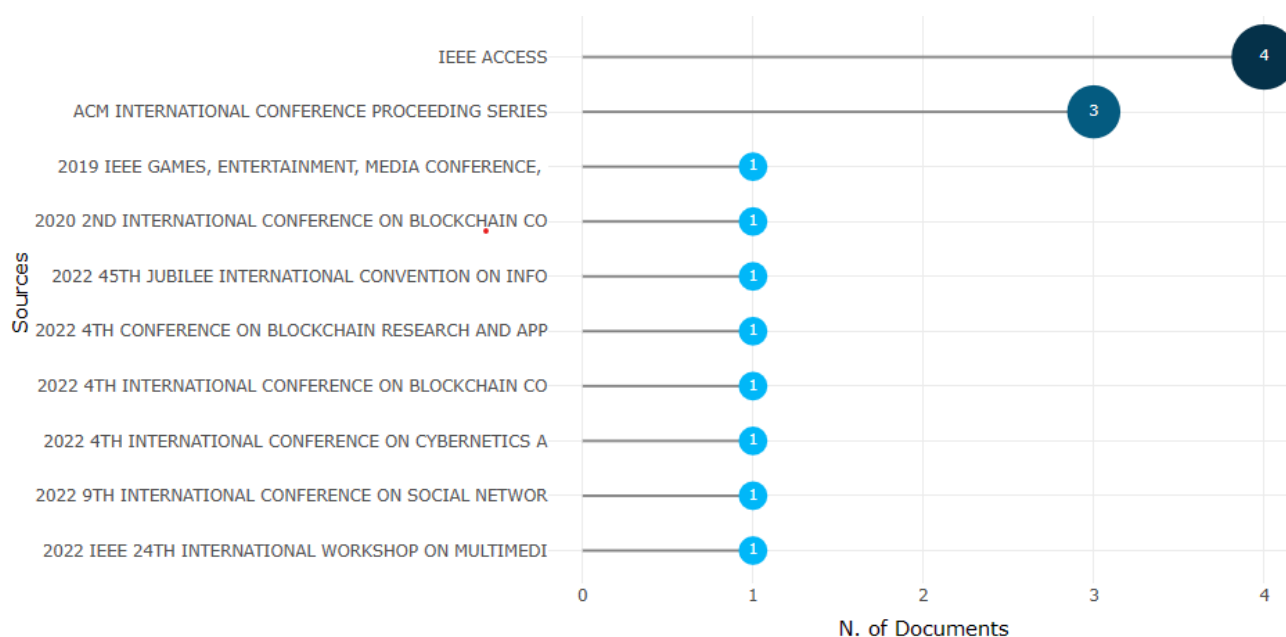


Fig. 2 Top Relevant Sources

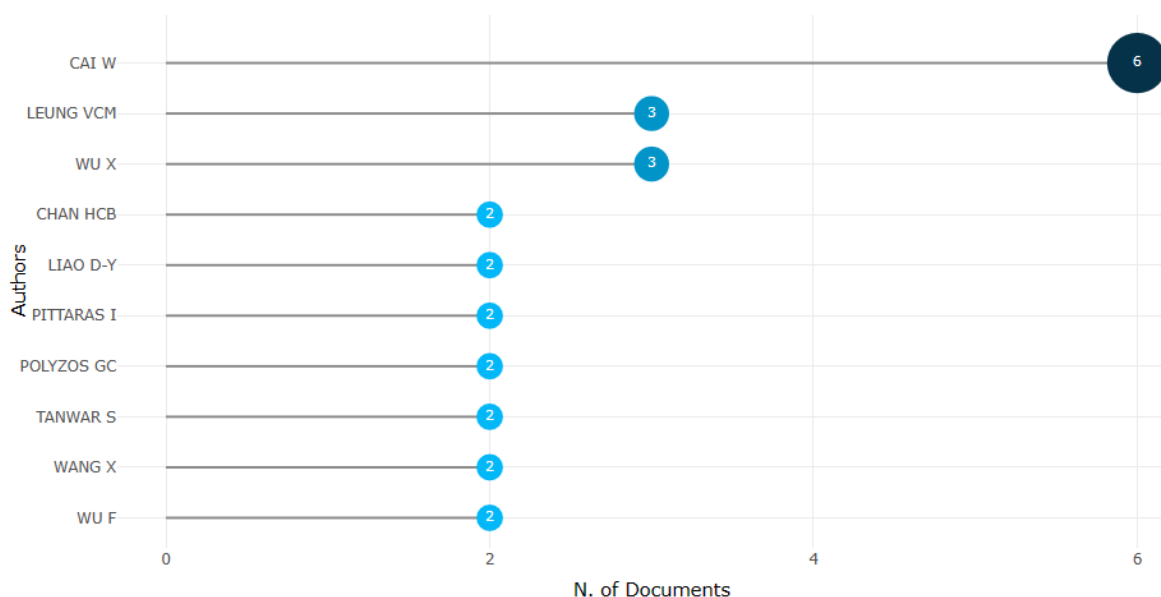
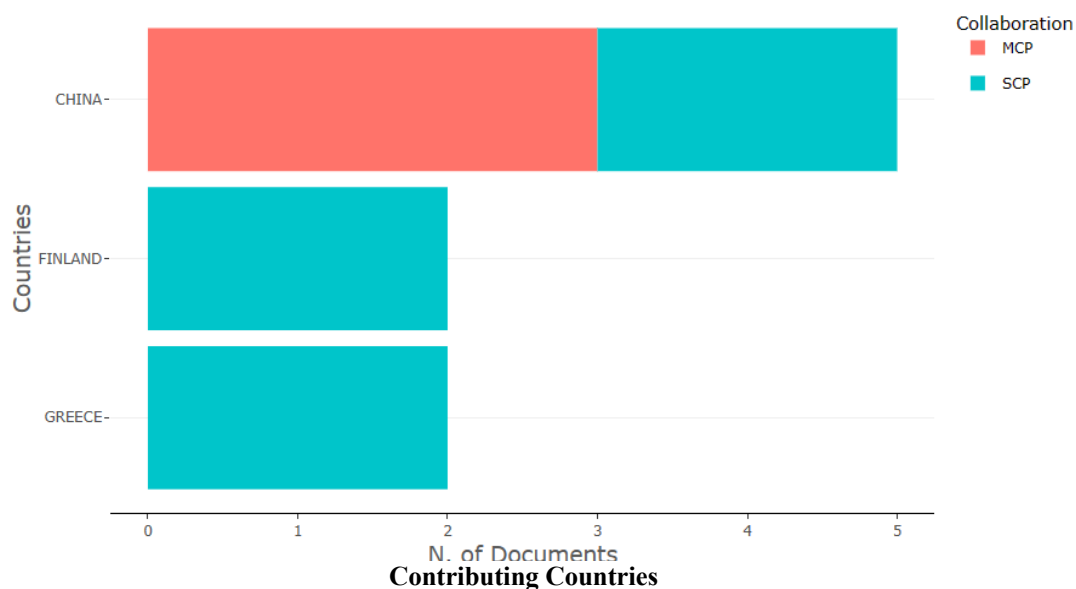
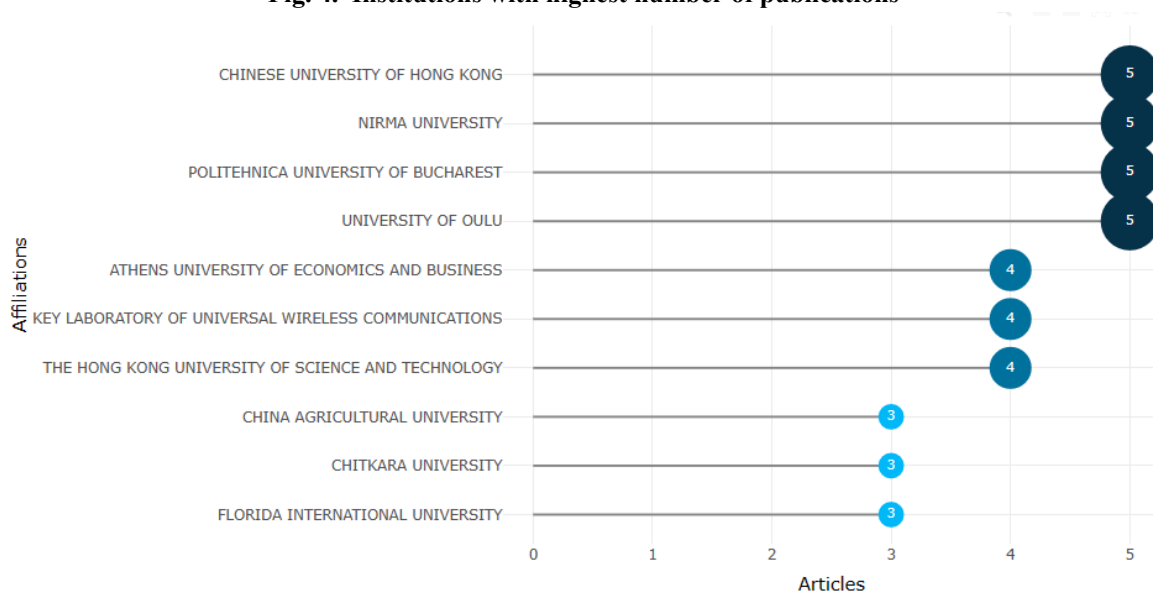


Fig. 3. Top Most Productive Authors**Statistics of influential authors, institutions and country**

The fig. 3 depicts the most productive authors in the blockchain and gaming literature which was taken from the Scopus database. Also, Fig. 4 depicts the top institutions to publish the works related to blockchain and gaming. The affiliation with the highest number of publications is Chinese University of Hong Kong with five publication, Nirma University with five publication, Politehnica University of Bucharest with five publication and University of Oulu with five publication. Overall, the list of institutions consists of university from all over the world. The major contributing countries is depicted in Fig. 5. It should be noted that the study has limited its search solely to English language.

Fig. 4. Institutions with highest number of publications**Fig. 5****Top****Table 1. Top keywords**

Keyword	Occurrences	Total link strength
augmented reality	2	2

Keyword	Occurrences	Total link strength
blockchain	32	58
cloud gaming	2	2
crypto-games	2	3
cryptocurrency	5	8
decentralization	4	12
decentralized applications	2	5
ethereum	8	16
framework	2	6
game	5	12
games	3	7
gamification	5	8
gaming	4	14
hyperledger fabric	2	2
metaverse	3	4
nft	2	5
non-fungible token	3	5
peer-to-peer	2	3
privacy	2	7
security	3	5
serious games	2	4
smart contract	2	5
smart contracts	8	18
software	2	6
transparency	2	7



Fig. 6.

Keywords

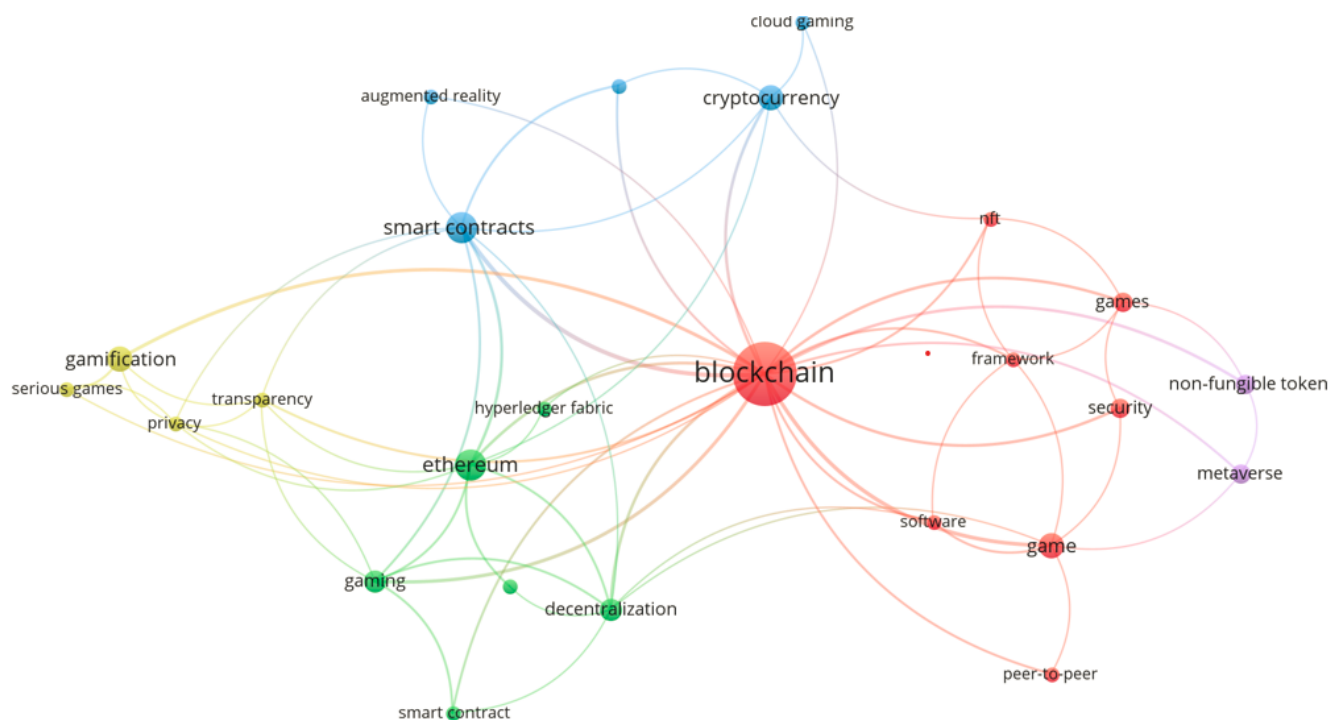


Fig. 7. Keyword co-occurrence network

Statistics of keywords

The Table 1 presents the 25 most occurring keywords in the literature. Following blockchain in terms of frequency are ethereum and smart contracts (eight each), then cryptocurrency. Ethereum are open source programmes that may be run without any centralised control. They are also referred to as the Blockchain 2.0 platform (Min et al., 2019). A completely distributed network of peers can be implicitly managed by the publicly accessible blockchains (Risius et al., 2017). As a self-executing contract between a buyer and seller that is directly written to the line of codes that exists across the distributed, decentralized blockchain network, smart contracts function similarly to a server and encode the logic to manage player assets (Peres et al., 2022). Researchers can define the structure of a field and uncover the primary content of the literature by analysing the keyword co-occurrence network as shown in Fig. 7. To generate the keyword co-occurrence the data was entered into VOSviewer, and density based spatial clustering with full counting method was used (Rejeb et.al., 2020). The frequency of the keyword was set to 2, resulting in 5 clusters depicted in 5 different colours. A node represents a keyword, and the size of the node is proportional to how frequently the term occurs together. For further analysis we considered most occurring keywords in each cluster, naming them based on the prominent characteristics.

Table 2. Keywords based on keyword co-occurrence clustering

No.	Cluster 1: Blockchain games for better security	Cluster 2: in Cluster 1: Ethereum Games	Cluster 3: Smart contracts and Games	Cluster 4: Gamification and Blockchain	Cluster 5: Non Fungible Token and Games
1	Software	Gaming	Augmented reality	Privacy	Metaverse
2	Games	Decentralization	Cryptocurrency	Transparency	
3	Security	Hyperledger	Cloud gaming	Serious games	
4	Software				
5	Peer-to-peer				

Conclusion

The primary objective of the article was to do a thorough assessment of the existing corpus of research on blockchain technology as it pertains to online games. A bibliometric analysis was undertaken to examine the literature on blockchain technologies. The findings will enable both managers and scholars to gain a comprehensive grasp of the literature, starting from its origins. Due to the limited amount of literature and the novelty of the subject, there is a scarcity of reviews available.

The above study provides several valuable insights. There has been a consistent increase in the number of publications since 2017. IEEE Access has published the most number of articles pertaining to the field. Cai W has the most number of publications among all writers. The Chinese University of Hong Kong is the most productive university in terms of its academic output. China, Finland, and Greece were the primary contributors to the research. After conducting our analysis, we have identified five significant clusters that should be explored in future research about the intersection of Blockchain and Online Gaming.

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