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Block Chain Technology and its Implications on Education: A Bibliometric Study Using Google Scholar Citations

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Abstract

Block chain technology has gained significant attention across various industries due to its potential to revolutionize traditional processes by providing transparency, security, and decentralization. In the dominion of education, block chain's impact is increasingly recognized as a promising solution for enhancing efficiency, authenticity, and accessibility. This bibliometric study explores the scholarly landscape surrounding block chain technology's implications on education by analyzing articles indexed in Google Scholar. Through bibliometric analysis, this study aims to identify key trends, prominent authors, influential journals, and emerging themes within the intersection of block chain and education. By examining citation patterns, publication trends, and thematic clusters, this research sheds light on the evolution and current state of knowledge in this field. Insights derived from this study contribute to a deeper understanding of the role of block chain technology in shaping the future of education, providing valuable guidance for researchers, educators, policymakers, and practitioners seeking to leverage block chain's potential to transform learning environments and educational systems.

Keywords : Block Chain Technology, Education, Bibliometric analysis, Relative growth study, Scientometrics, Citation analysis

1. Introduction

In recent years, block chain technology has emerged as a disruptive force with transformative potential across various sectors, including finance, healthcare, supply chain management,

and beyond. Its decentralized, secure, and transparent nature has spurred exploration into its applications within the realm of education. Block chain technology offers promising solutions to longstanding challenges in education, such as credential verification, academic record management, and secure distribution of educational resources. As interest in the intersection of block chain and education grows, it becomes imperative to understand the scholarly landscape surrounding this emerging field

This paper presents a bibliometric study that aims to explore the implications of block chain technology on education, leveraging Google Scholar citations as a primary data source. Bibliometrics, a quantitative analysis of publications and citation patterns, provides valuable insights into the evolution, trends, and impact of research within a specific domain. By applying bibliometric techniques to articles indexed in Google Scholar, this study seeks to uncover key themes, influential authors, prominent journals, and emerging research directions in the intersection of block chain technology and education

2. Review Related literature

Aleksandra Kuzior and Aleksandra Kuzior studied A Bibliometric Analysis of Block chain Technology Research Using VOSviewer. They retrieved the data from scopus database and analysed by using VOSviewer software. They studied 1842 documents published in duration 2007-2021.(Kuzior&Sira, 2022)

Erik Karger and others studied block chain technology in smart cities a bibliometric analysis and overview. Authors studied research publications on the mentioned topic published between 2014 to 2021.(Karger et al., 2023)

The blockchain technology has gained attention of researchers. This study is the visualization on the block chain based supply chain. Articles published in the duration 2017 to April 2022 from Scopus and Web of Science were analysed after applying search string inclusion and exclusion criteria. (Shoaib et al., 2023)blockchain widely finds its applications in the supply chain to mitigate issues related to transparency, information sharing, process efficiency, and traceability. This study employed a knowledge-based visualization technique to create a vision beyond other review studies on the blockchain-based supply chain. We used bibliometric and network analysis to synthesize the previous literature. In total, 431 articles in the timespan of 2017 to April 2022 from Scopus and Web of Science (WOS

Benjamin Müßigmann and others studied bibliometric analysis of block chain technology in logistics and supply chain management. The study revealed citation network analysis and a co-citation analysis. this article classifies the existing literature into five different research clusters, including theoretical sense making, conceptualizing and testing block chain applications, framing BCT into supply chains, the technical design of BCT applications for real-world LSCM applications, and the role of BCT within digital supply chains.(Müßigmann et al., 2020)

Naghmeh Niknejad [a] and others studied bibliometric analysis of block chain technology in food and agriculture industry. The authors took data from the Scopus database They studied 171 papers of 561 authors. To retrieve the relevant resources in the specific field, they used 421 keywords. Block chain Technology in Food and Agriculture Studies: A Bibliometric Analysis" offers a rigorous examination of an emerging field, employing bibliometric analysis to provide valuable insights (Niknejad et al., 2021)

3. Objectives :

1. To assess the growth and trends in scholarly publications related to block chain technology in the field of education over a specific period.
2. To identify the most influential authors, institutions, and countries contributing to research on block chain technology in education through bibliometric analysis.

4. Methodology

The data for present study is retrieved from Google Scholar database. Block Chain technology and Education search string is given and selected 485 most relevant articles published in duration 2018-2024. Search results were exported in a suitable format for analysis. Dupicate records were removed and filtered the irrelevant articles.

Bibliometric analysis: Collected data is analysed with the help of MS Excel. Information forms were identified and counted to bring out the form wise distribution of resources. Publications published in each year of duration 2018-2024 were counted to study the publication growth. Each publication checked for its geographic belonging and counted to find the geographic distribution of publications. Authors study was carried out to find the most influential authors in the field. Publications were divided in single authored and multiple authored and then calculated the degree of collaboration in the specific field and duration.

5. Findings and Discussion

5.1. Form wise distribution of literature:

Google scholar indexed the literature available in all forms of resource like Book chapters, Journal articles, Preprints, Research papers, conference proceedings. To check the availability of literature in various forms of resources the search was not restricted to one form. 485 most relevant sources were took for the study. The distribution of resources based on their forms is given in the following table 1. 45% of literature is published in journals and 29% in Conference proceedings ad 20% books and e books.

Table 1 Form wise distribution of literature

S.No	Type of resources	No. of Publications	Cumulative no of Publications	Publications %	Cumulative %
1	Journals/E-Journals	223	223	45.979381	45.97938
2	Conference Proceedings	142	365	29.278351	75.25773
3	Books/E-Books	99	464	20.412371	95.6701
4	Thesis	3	467	0.6185567	96.28866
5	Research papers	8	475	1.6494845	97.93814
6	Preprints	9	484	1.8556701	99.79381
7	Research Gate	1	485	0.2061856	100
	Total	**485**	**485**	**100**	**100**

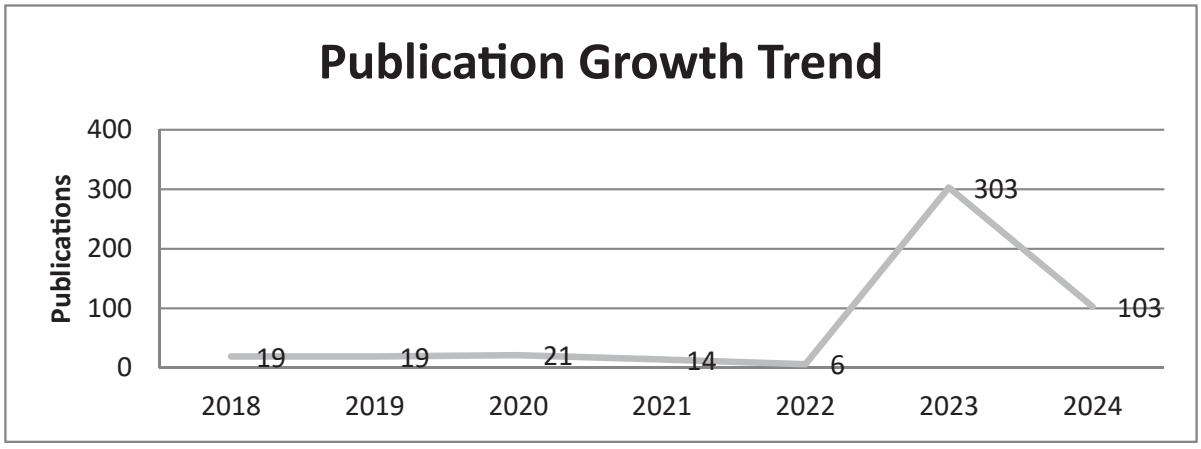
5.2. Publication Growth. :

The publication growth in the field "Block Chain Technology and its implications in Education" was analysed in this study by dividing the publications by their publication year. Publications published in the duration 2018 to 2024 were taken for the present study. The year wise distribution of publications is given in the table 2. It is observed from the data set there is a continuous growth in publications. There was no much difference in number of publications from 2018 to 2021 and there is abrupt and slight decrease in the year 2022 and swift increase in the year 2023. The data was extracted in the March month of 2024, and it is observed 103 publications. In remaining 9 months of the 2024 publication growth will be expected more than 2023.

Table 2 Year wise distribution of publications

Sl. No	Year	No. of citations	Cumulative No. of citations	Percentage	Cumulative %
1	2018	19	19	3.91752577	3.91752577
2	2019	19	38	3.91752577	7.83505155
3	2020	21	59	4.32989691	12.1649485
4	2021	14	73	2.88659794	15.0515464
5	2022	6	79	1.2371134	16.2886598
6	2023	303	382	62.4742268	78.7628866
7	2024	103	485	21.2371134	100
	Total	**485**			

Fig 1. Publications Growth Trend



5.3 Relative Growth Rate (RGR) AND Doubling Time (Dt.)

The Relative Growth Rate (RGR) is the increase in number of articles / pages per unit of time. The mean Relative Growth Rate (RGR) over the specific period of interval can be calculated from the following equation:

$$R(P) = \frac{\text{logeW2} - \text{logeW1}}{T2 - T1}$$

Whereas R(P) → Mean relative growth rate over the specific period of interval
logeW1 → natural logarithm of initial number of articles
logeW2 → natural logarithm of final number of articles after a specific period of interval
T2 – T1 → the unit difference between the initial time and the final time

Doubling Time (Dt.)

The doubling time (Dt.) is the period requires for a quantity to double in size or value. This can be calculated by the formula

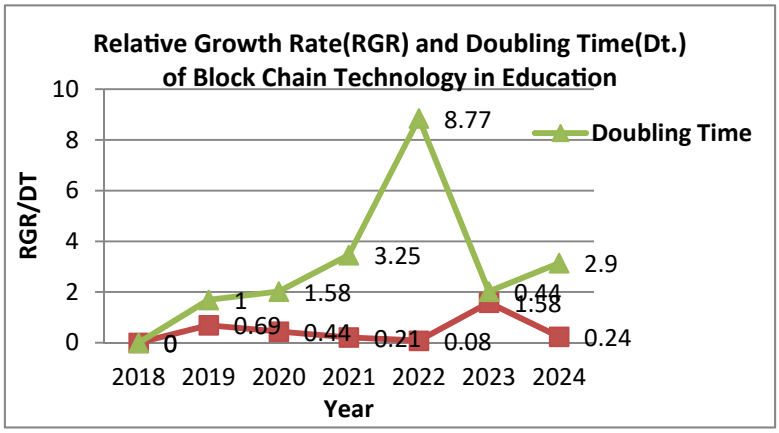
$$Dt(P) = \frac{Loge2}{R(P)} = \frac{0\ 693}{R(P)}$$

Where Dt (P) →Average doubling time of publications

Table 3: Relative Growth Rate(RGR) and Doubling Time(Dt.) of Block Chain Technology in Education

Year	Total Articles	Cumulative Articles	ln (p)	RGR	dt (P)
2018	19	19.00	2.94		
2019	19	38.00	3.64	**0.69**	**1.00**
2020	21	59.00	4.08	**0.44**	**1.58**
2021	14	73.00	4.29	**0.21**	**3.25**
2022	6	79.00	4.37	**0.08**	**8.77**
2023	303	382.00	5.95	**1.58**	**0.44**
2024	103	485.00	6.18	**0.24**	**2.90**
Mean Value				**0.46**	**2.56**

Fig 2 Relative Growth Rate (RGR) and Doubling Time(Dt.)



The table 3 and Fig 2 depicts the total Relative Growth Rate (RGR) and Doubling Time (Dt.)

of Block Chain Technology in Education for the block period 2018-2024. It is observed that there is a varied growth in output year by year both in the Relative growth rate and doubling time. The mean value for RGR is 0.46 shows positive growth in the publications whereas the literature doubles for 2.56 years in the block period under study.

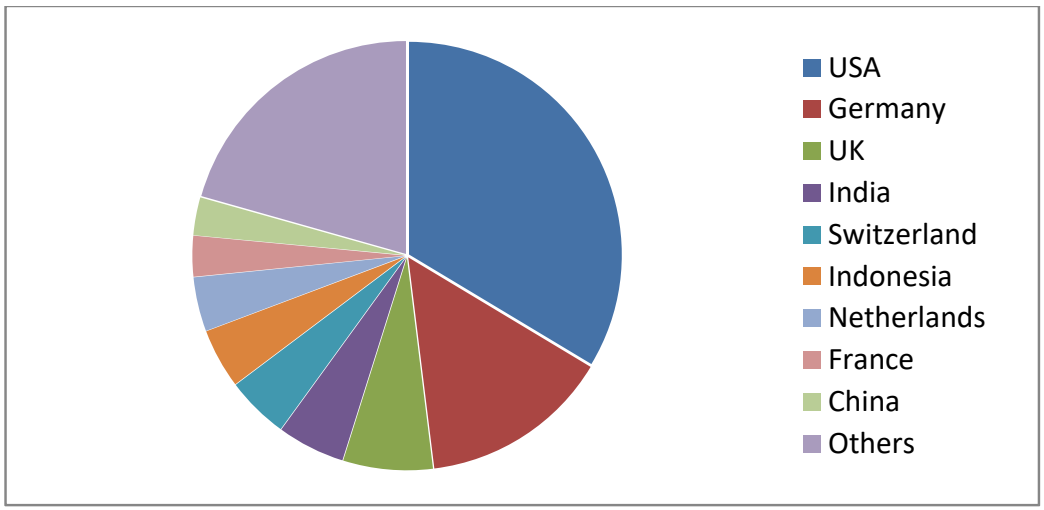
Geographic distribution of Publications

The geographic distribution of publications reflects the dissemination of knowledge and research across different regions of the world. This distribution not only reflects the concentration of research activity in certain regions but also highlights the global exchange of ideas and collaboration among researchers. Factors such as language, culture, funding availability, and institutional infrastructure influence the distribution patterns, with some regions emerging as hubs of research excellence in specific fields. Analysing the geographic distribution of publications provides valuable insights into the global landscape of research, fostering cross-cultural understanding, and identifying areas for potential collaboration and knowledge exchange. The following table 4 and fig 3 gives the insight to the geographic distribution of publications. It is observed from the data analysis; USA produced highest publications in this topic. The second highest is Germany and third is UK. India is in fourth position in producing publications on this topic.

Table 4 Geographic distribution of Publications

Sl. No	Country	No. of Publications
1	USA	163
2	Germany	70
3	UK	33
4	India	25
5	Switzerland	23
6	Indonesia	22
7	Netherlands	20
8	France	15
9	China	14
10	Others	100
	Total	**485**

Fig 3 Geographic distribution of Publications



5.5 Authorship pattern and degree of collaboration

Authorship pattern refers to the distribution and characteristics of authors within a particular field, discipline, or publication. It encompasses the trends and tendencies regarding who is producing scholarly or creative work, how frequently they are contributing, and their collaboration patterns. Authorship patterns can vary significantly across different domains, influenced by factors such as disciplinary norms, research methodologies, and cultural contexts. Studying authorship patterns can provide insights into the dynamics of knowledge production, interdisciplinary collaborations, and the evolving landscape of academia or creative industries.

There were total 1441 authors have worked to produce 485 articles in the field of study. Khan Firoz and Ramsamy Lakshmana Kumar are the highest producers of the articles in the subject and in during specific time 2018-2024. The list of authors who have authored more than one paper is given in the following table 5. The data of table 3 indicates that 54 authors have written more than one paper.

Table 5 List of authors who have more than one paper

Sl No	Author	No.of articles
1	Khan, Firoz	9
2	Ramasamy, Lakshmana Kumar	9
3	Asuzu, Onyeka Franca	3
4	Gadekallu, Thippa Reddy	3
5	Ndubuisi, Ndubuisi Leonard	3
6	Singh, Rajesh	3
7	Aliu, John	2
8	Caramihai, Mihai	2
9	Dai, Hong-Ning	2
10	Ehiosun, Lydia Uyi	2
11	Faturahman, Adam	2

Sl No	Author	No.of articles
12	Flanagan, Brendan	2
13	Gehlot, Anita	2
14	Ghazali, Osman	2
15	Gunasekaran, Angappa	2
16	Haleem, Abid	2
17	Huynh-The, Thien	2
18	Ilugbusi, Bamidele Segun	2
19	Kanenishi, Kazuhide	2
20	Kesavamoorthy, R	2
21	Khoirunisa, Alfiah	2
22	Kondo, Akiko	2
23	Li, Lu	2
24	Liu, Dennis YW	2
25	Obi, Ogugua Chimezie	2
26	Oganda, Fitra Putri	2
27	Ogata, Hiroaki	2
28	Patil, Manoj Eknath	2
29	Rahardja, Untung	2
30	Ruland, Rudolf	2
31	Salah, Khaled	2
32	Srivastava, Gautam	2
33	Tyagi, Amit Kumar	2
34	Vig, Shinu	2
35	Wang, Jiaqi	2
36	Wu, Yirui	2
37	Yenduri, Gokul	2
38	Aparna, N	2
39	Bodemer, Oliver	2
40	Dwivedi, Sunita	2
41	Kumari, Sony	2
42	Lam, Duc Khai	2
43	Leung, Alven CY	2
44	Lukita, Chandra	2
45	Ma, Hanlin	2

Sl No	Author	No.of articles
46	Nguyen-Ngoc, Minh-Chau	2
47	Ningning, Lan	2
48	Ocheja, Patrick	2
49	Oke, Ayodeji Emmanuel	2
50	Rashmi, C	2
51	Saleh, Omar S	2
52	Togawa, Satoshi	2
53	Liyanage, Madhusanka	2
54	Zavala, Genaro	2

The following table no 6shows the authorship pattern in the specified study. It is found that 103 papers are single authored, and rest are of two and more authored papers.

Table 6 Authorship pattern

Sl. No	No. Of authors	citations	Cumulative	%	Cumulative %
1	1	103	103	21.2371134	21.2371134
2	2	120	223	24.74226804	45.97938144
3	3	76	299	15.67010309	61.64948454
4	4	79	378	16.28865979	77.93814433
5	5	52	430	10.72164948	88.65979381
6	6	28	458	5.773195876	94.43298969
7	7	13	471	2.680412371	97.11340206
8	8	6	477	1.237113402	98.35051546
9	9	1	478	0.206185567	98.55670103
10	10 and more	7	485	1.443298969	100
		485		100	

Degree of collaboration in the field block chain technology and education is calculated as DC = Nm/Nm+NS
Single authored papers Ns = 103
Multiple authored papers Nm = 382

Degree of Collaboration in present study is 0.787

6. Conclusion :

This bibliometric study provides valuable insights into the evolving landscape of research on block chain technology in education. By examining publication trends, influential authors, interdisciplinary connections, and thematic focus, this research contributes to a deeper understanding of the role of block chain technology in shaping the future of education. These

findings offer guidance for researchers, educators, policymakers, and practitioners seeking to leverage block chain's transformative potential to revolutionize learning environments and educational systems. As the field continues to evolve, further research and collaboration will be essential to harnessing the full benefits of block chain technology in education and driving innovation in the years to come.

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