Financial Technology (Fintech): Current Research at The Cutting Edge

[1] Maslinawati Mohamad*, [2] Salwa Zolkaflil, [3] Hairul Suhaimi Nahar

[1] Faculty of Accountancy, Universiti Teknologi MARA, Selangor Campus, Puncak Alam Branch, Selangor, Malaysia

[2] Accounting Research Institute, Universiti Teknologi MARA, Malaysia

[3] Accounting Department, College of Economics and Political Science, Sultan Qaboos University, Muscat, Sultanate of Oman

*** Corresponding Author**

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ABSTRACT

Purpose – This study analyses the frontier of financial technology (FinTech) research repertoire by identifying essential features to direct future research in the sector. This research used bibliometric and citation analysis. Scopus yielded 1,011 data points linked to the article titled FinTech. Numerous programmes were used, including Microsoft Excel to perform the frequency study, VOSviewer to visualise the data, and Harzing's Publish or Perish to calculate and analyse citation metrics. The analysis results suggest that FinTech is a cross-disciplinary research area where past literature concentrated mainly on business-related and environmental science domains. The growing number of publications on FinTech demonstrates that the critical nature of technology has affected the financial services sector, and there are undoubtedly some ramifications for the economy. The data sources selected are from the Scopus database only. This study is the first bibliometric examination of FinTech utilising a 38-year-old publication database.

Keywords: FinTech, Financial Technology, Bibliometric Analysis, Big Data, Cyber Security

INTRODUCTION

FinTech is a phrase that refers to technology that enables the improvement and automation of the use and supply of financial services. Financial institutions, businesses, small company owners, and individuals often use it to help them manage their financial operations, procedures, and even their daily lives more effectively. Most of the time, FinTech uses specialised software and algorithms on computers. Arner *et al.* (2015) identified a pivotal moment in the timetable for FinTech implementation. The introduction of Industry Evolution (IR) 4.0 has changed life as the world moves towards automation and digitalisation. In line with IR 4.0, the financial institutions have ventured into FinTech, which assists, supports, and manages their financial activities using specialised applications and software. FinTech facilitates the public in performing business transactions from anywhere (World Banks, 2018; Demirgüç-Kunt *et al*., 2018; Gai *et al.*, 2018), which gives flexibility to all actors (Anshari *et al.*, 2019). To remain competitive in the market, the financial institutions have to support the adaptation of FinTech to ensure their sustainability in the competitive market. The FinTech industry is a driving force for sustainable economic growth with several effects on social, environmental, and ecological benefits that can make financial business more sustainable, as it promotes green finance or sustainable finance (Chueca Vergara and Ferruz Agudo, 2021; Nahar, Mohamad and Abd Rahman, 2022).

Hence, research on FinTech has been widely discussed by scholars, policymakers, and law enforcement agencies, yet there are still areas to be explored. It is practically and academically imperative for academic literature to look back at previous FinTech research, thereby providing the necessary reflections on what had been done so far and what could be done to shape the trajectory of practical and empirical FinTech knowledge.

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Accordingly, this study explores the FinTech research repertoire by delineating critical research attributes under the general theme of FinTech, which are arguably crucial in guiding the path of future FinTech research. Using the commonly applied scientific analytical approach of bibliometric analysis, 1,011 FinTech-related papers published in the Scopus database were identified and analysed. These papers were published between 1984 to 2022 in various Scopus indexed outlets. *The following research questions (RQs) are addressed: RQ1: What is the current state of FinTech publication? RQ2: What are the most productive contributors to FinTech research? RQ3: Which are the most influential articles on FinTech? RQ4: What are the authorship patterns of the publication in FinTech? RQ5: Which themes of FinTech are most popular among researchers?*

Previous researchers such as Li and Zu (2021) limit their work review to 1995 to 2021, using only the WoS database. Nasir *et al.* (2021) only cover the analysis for 2010 to 2021, and Tepe *et al*. (2021) cover the analysis period only for 2015 to 2021. Our literature review differs from those of other authors in several ways. First, earlier reviews used a more limited data period than our study. We identify critical research properties for early and/or matured researchers to plan their future research trajectory in the current research. Researchers will be presented with readily available empirical and literature gaps based on the analyses conducted. Second, we identify the most important conceptual framework that underpins the present FinTech publications. It presents research endeavour of bibliometric analysis on FinTech research using the established publication database over 38 years, leading to more data coverage.

The following is the order in which the paper is presented. The following section briefly describes FinTech and then discusses the approach used to locate data from previous FinTech-related papers and the analytical methodologies utilised. The functional analysis is given next, followed by the findings section. The last part ends by discussing the ramifications of the results.

LITERATURE REVIEW

FinTech: An overview

FinTech, according to Leong and Sung (2018), may also be defined as "any creative concepts that enhance financial service operations by providing technological solutions based on various business circumstances." After the global financial crisis in 2008, advances in e-finance and mobile technologies for financial firms fueled FinTech innovation. This development defined e-finance innovation, internet technology, social networking services, artificial intelligence, and extensive analytic data. The word "FinTech" refers to information technology applications in finance, financial innovation, and digital information (Zavolokina *et al.*, 2020). All industries and business sectors face difficulties as a result of digital transformation. The evolution of digital transformation has also obviously spurred the creation of FinTech (financial technology) initiatives, which are often regarded as some of the most significant breakthroughs in the financial sector. This puts pressure on many conventional financial organisations, such as banks, to create more realistic business models (Gimpel *et al*., 2018). Insurance services, crowdfunding, payment, lending, wealth management, and capital markets are the six FinTech business models (Davis *et al*., 2017).

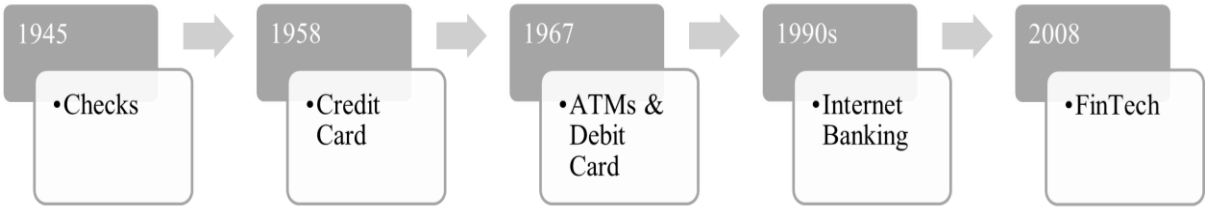

Figure 1: Technical Innovation in Financial Industries

The origins of technical innovation in the financial industry may be traced back to introducing checks as payment (1945). Following that, the Bank of America issued the first credit card in 1958, and automatic teller machines (ATMs) aided in processing financial transactions in 1967, followed by the release of a debit card as a transaction

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instrument. Internet banking was introduced in the 1990s, aided by the development of the Internet. FinTech, or finance and technology combined, has been around for now. A more recent network that handles real-time processes among banks was introduced in 2008 (Alt, Beck, and Smits, 2018). It is the only way to see how FinTech compares with others in wealth and possessions. With so many new functions and tools available in the technology industry, it is easier than ever to track account balances on the phone. There are many categories of FinTech available in the market, namely financing, asset management, payment, insurance, loyalty programs, risk management, exchanges, and regulatory technology (Haddad and Hornuf, 2019). However, financing is seen as the most important segment, followed by payment, asset management, insurance, loyalty programs, risk management, exchanges, and regulatory technology.

Benefits of FinTech

One small example of what FinTech has done is make financial matters easy and accessible to all people who might not afford a broker or traditional banks (Laldin, 2018). There is no longer a need to go to a bank branch. With FinTech, banking is done faster, easier for less money and with more security. Users can even open bank accounts while on vacation or business trips. These are the many ways FinTech has changed the finance world. Companies that sell financial products and services to consumers are noted spending habits based on spending their money. Accurate records can give them a good insight into where people spend their money and may even help them decide what products to offer in the future.

FinTech solutions have been around for a while, but the best ones improve as technology advances. FinTech offers businesses and investors a better way to find out what is going on with their money. Users can now check account balances at any time of the day. The possibilities are endless, from checking bank accounts and credit cards to more complex financial products like prepaid cards or more traditional investments like stocks, trusts, derivatives or bonds. FinTech can be a huge help for busy consumers who always want things done quickly and conveniently.

FinTech is also less costly and less time-consuming than the traditional banking system. FinTech lending is more efficient because it can reduce frictions in the application process, such as the mortgage origination process (Fuster *et al.*, 2019). The loan processing period has also been reduced by 20% faster without raising their risk profile. Hence, FinTech can respond more elastically to changes in exogenous mortgage demand shocks (Agarwal and Chua, 2020).

Identification is one of the most significant aspects that FinTech has created (Wang, 2021). It is so indispensable today that it may be the next big thing in banking. With all of the money being opened, stolen, lost or spent in irregular ways, identity theft has become common. FinTech introduces new technology for tracking money and identification, which helps detect irregular transactions more easily and quickly. This way, users will learn what occurred to their account without hassle or bother. It also keeps track of every transaction and movement in users' bank accounts.

FinTech has many different styles, tools and styles that users can choose from depending on what they need. There are some centralised ones where everything happens on the bank's servers, while some others are decentralised where the data is saved on a blockchain or similar technology, while others still offer both options to their users depending on their preferences (Naik *et al.*, 2020). FinTech has gotten to a point where it is almost impossible to find a bank that does not offer some FinTech tools to its customers. However, some people are still hesitant about using them because they do not understand how they work or see the difference between what they have now and what it used to be in the past.

Challenges in adopting FinTech

Whether it is a savings account, home loan, car finance, credit card or insurance quote, FinTech disrupts how the business operates. As the world moves to digital and consumer demands change, FinTech is no longer an

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option. FinTech has become the norm. However, there are many challenges in adopting FinTech, and the benefits outright the challenges. More people become aware of what it offers and are satisfied with the performance.

Many people still find technology confusing and fear giving up their traditional bank due to security concerns (Broby, 2021). Some people do not know where to start when choosing a FinTech product. There are often complaints about customer service. In some cases, people have reported being locked in or unable to get their money out of the product. Unfamiliar with the product interface is one of the challenges in FinTech adoption (Gomber *et al.,* 2018). Since the FinTech sector will develop over time, there is a need to contribute new knowledge in this vibrant area of technology innovation, process disruption, and services transformation to enhance FinTech adoption.

Other challenges include cyber security and data protection concerns and not knowing how transactions will be managed, stored, and paid into users' bank accounts. Some people are concerned about their protection if something goes wrong with the product. Nevertheless, some people find it far more expensive to deal with their banks than with FinTech providers (Das, 2019). Sometimes there are hidden costs associated with FinTech products that can catch people out. For example, a credit card charges a fee every time you use the card abroad. This mentality is mainly due to the few assumptions of facing high fees associated with overdrafts and foreign transactions compared with FinTech providers, who tend not to charge anything extra.

METHODS

Bibliometric Analysis

The scientific-analytical approach to bibliometric analysis employs suitable statistical techniques to examine many published reading materials, including books, journals, and other works. The bibliometric approach based on citation graph construction, which effectively refers to a network or graph representation of the citations between documents, is widely used in library and information science. Its specific analytical tool of "Citation Analysis" represents part of the bibliometric approach based on citation graph construction which effectively refers to a network or graph representation of the citations between documents (Linnenluecke *et al.,* 2020; Schaer, 2013). This phase allows for impact assessments of many aspects, such as the chosen research area, the group of researchers, the published material, and selecting the most critical articles within a specific field of study (Donthu *et al.,* 2021; Ellegaard and Wallin, 2015).

This study extracted data from Scopus as of 6th September 2021. The search of the data is based on article titles related to FinTech, such as "FinTech" OR "fin-tech" OR "financial technology" OR "financial technologies" OR "finance technology" OR "finance technologies" OR "e-finance" OR "electronics finance". From the data search, we selected and analysed 1,011 article titles related to FinTech. Figure 1 shows the data search and data selection process. The VOSViewer software is used to conduct bibliometric analysis to analyse the data. In addition, Ms Excel is used to calculate the frequencies and design graphs and charts to support the results retrieved from the bibliometric analysis. Besides that, Harzing's Publish or Perish software calculates the citation metrics and other frequencies.

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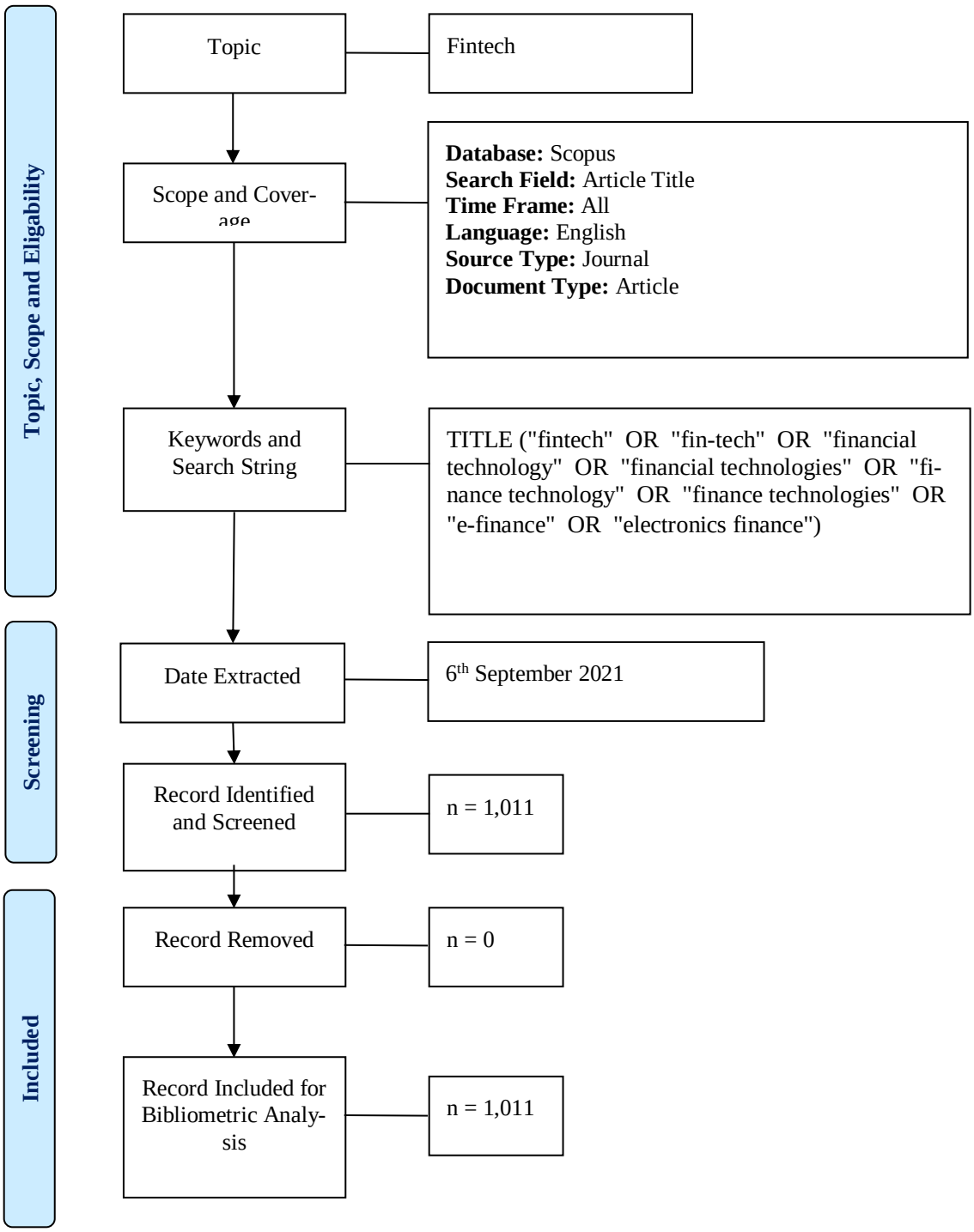

Figure 2[1]. Flow diagram of the data search strategy.

RESULTS

Based on the data gathered from the Scopus database, this study will analyse the bibliometric attributes via VOSViewer software, such as type of document, type of source, type of language, and subject area. We also analysed the research trends such as the number of publications based on the year, the countries that contributed to the publication, the most influential institution that contributed to the publication, the most productive authors,

[1] **Source:** Modified from PRISMA (Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6 (7): e1000097. doi:10.1371/journal. pmed1000097)

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and the most active sources. In addition, we run the citation analysis to obtain the frequency of the citation on publication and use the VOSViewer software to design the network visualisation map.

4.1 Document Profiles

We start our discussion on the finding with our RQ1 *(RQ1: What is the current state of FinTech publication?).* From 780 data extracted from Scopus, we analysed the documents' profiles related to FinTech. Panel 1 of Table 1 shows the details of the type of document. Out of 780 documents, more than 70% (601 documents) are article, 12.31% (96 documents) are book chapter, and 7.44% (58 documents) comprises review, and 3.21% (25 documents) are editorial documents. The documents are further divided according to the type of source. Panel 2 shows the frequencies of the documents based on the type of source. There are 675 journals (86.54%), 61 (7.82%) books, 42 book series (5.38%), and another 0.26% comprise trade journals.

Table 1. Document Profile

Panel 1. Document Type

Document Type	**Total Publication**	**Percentage (N=780)**
Article	601	77.05%
Book Chapter	96	12.31%
Review	58	7.44%
Editorial	25	3.21%

Panel 2. Source Type

Source Type	**Total Publication**	**Percentage (N=780)**
Journal	675	86.54%
Book	61	7.82%
Book Series	42	5.38%
Trade Journal	2	0.26%

Panel 3. Subject Area

Subject Area	**Total Publication**	**Percentage (N=780)**
Agricultural and Biological Sciences	5	0.64%
Arts and Humanities	14	1.79%
Biochemistry, Genetics and Molecular Biology	10	1.28%
Business, Management and Accounting	397	50.90%
Chemical Engineering	4	0.51%
Chemistry	3	0.38%
Computer Science	201	25.77%
Decision Sciences	55	7.05%
Environmental Science	40	5.13%
Health Professions	1	0.13%
Materials Science	10	1.28%
Mathematics	13	1.67%
Medicine	4	0.51%
Multidisciplinary	6	0.77%
Pharmacology, Toxicology and Pharmaceutics	4	0.51%
Physics and Astronomy	5	0.64%
Psychology	14	1.79%

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Economics, Econometrics and Finance	323	41.41%	Social Sciences	224	28.72%
Energy	30	3.85%	Veterinary	1	0.13%
Engineering	88	11.28%			

There are many subject areas where the research in relation to FinTech was conducted and published. Panel 3 shows the number of publications according to the subject areas. Among 780 documents that are related to FinTech, there are 397 (50.90%) documents that were published in Business, Management, and Accounting, 323 (41.41%) publications in Economics, Econometrics and Finance, 224 (28.72%) publications in Social Sciences, 201 (25.77%) in Computer Science, 88 (11.28%) publications in Engineering and 55 (7.05%) publications in Decision Sciences. The complete publication contains more than 780 documents.

4.2 Research Trends

In this study, we also observe the research trends about FinTech (*RQ2: What are the most productive contributors to FinTech research?).* We run the citation metrics using Harzing's Publish or Perish to analyse the researcher's productivity (author). The researcher's productivity is measured based on citations, citations per year, and the average citations per cited publication. We retrieved the data from 1984 to 2022 related to FinTech from Scopus. It shows that the data consists of 38 years of publication. Despite this, it is very important to understand that the number of citation years is 37, i.e., from 1984 to 2021

Table 6 shows the top 10 countries that contributed to the publications in FinTech. The United States of America (USA) is ranked first (139:13.75%) among the 20 countries that contribute to the publications on FinTech. Next is China (123:12.17%) and Indonesia (107:10.58%). The United Kingdom and India are ranked fourth and fifth with total publications of 97 (9.59%) and 57 (5.64%), respectively.

Table II. Publications Profile

Panel 1. Top 10 Countries Contributed to the Publications

Country	**TP**	**%**	**Country**	**TP**	**%**
United States	115	14.74%	India	42	5.38%
China	99	12.69%	South Korea	42	5.38%
United Kingdom	86	11.03%	Germany	35	4.49%
Indonesia	59	7.56%	Malaysia	31	3.97%
Australia	43	5.51%	Italy	24	3.08%

Panel 2. Top 10 Most Active Source Titles

Source Title	**TP**	**%**	**Publisher**	**Cite Score**	**SJR 2020**	**SNIP 2020**
Sustainability Switzerland	16	2.05%				

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Financial Innovation	13	1.67%				
Economist United Kingdom	12	1.54%				
International Journal of Advanced Science And Technology	10	1.28%				
Journal of Payments Strategy And Systems	10	1.28%				
Finance Research Letters	8	1.03%				
Journal of Open Innovation Technology Market And Complexity	8	1.03%				
Perspectives In Law Business And Innovation	8	1.03%				
Routledge Handbook of Financial Technology And Law	8	1.03%				
Studies In Computational Intelligence	8	1.03%				

Notes: TP=total number of publications

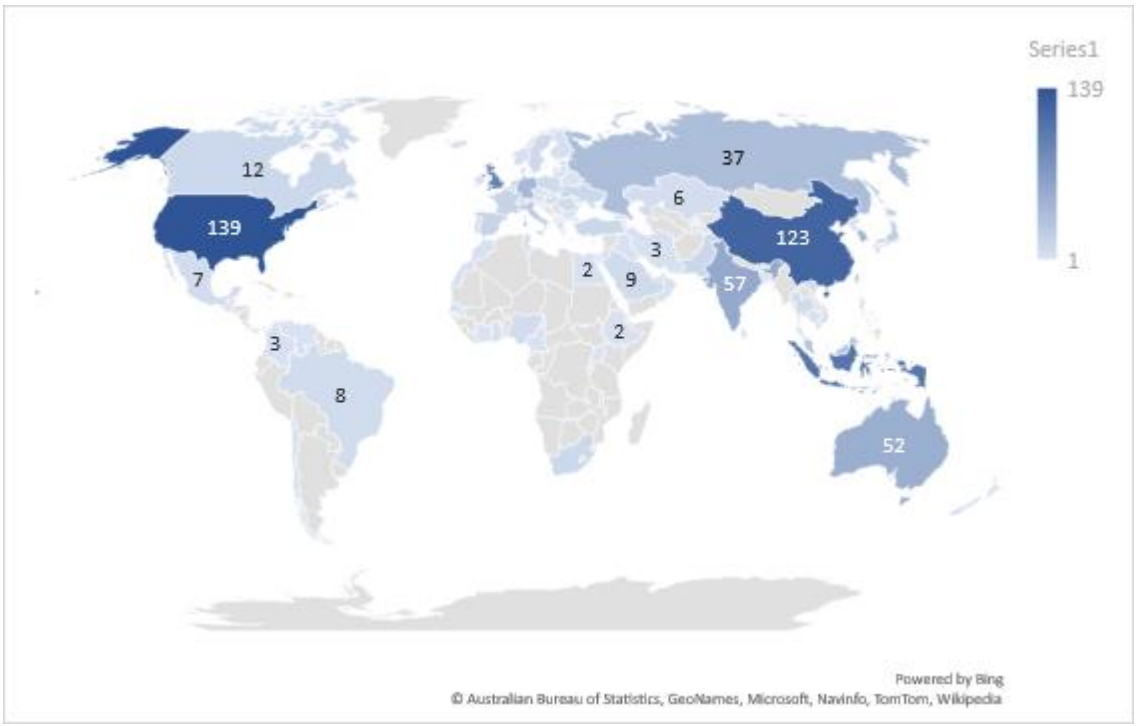

Figure 2: Geographical distributions of publications

Table 7 indicates the results of the most influential institutions that have contributed to the publications in FinTech for the past 38 years, i.e., from 1984 to 2022. This result is retrieved by limiting the counting of the frequencies to a minimum of five institutions' publications. Bina Nusantara University and Universitas Indonesia are the top influential institution with 22 (2.18%) and 15 (1.48%) publications, respectively, followed by UNSW Sydney (13:1.29%), The University of Sydney (12:1.19%), and Amity University (10:0.99%).

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Table 7. Most influential institutions with minimum of five publications

Institution	Total Publication	Percentage (N=780)
United States	115	14.74%
China	99	12.69%
United Kingdom	86	11.03%
Indonesia	59	7.56%
Australia	43	5.51%
India	42	5.38%
South Korea	42	5.38%
Germany	35	4.49%
Malaysia	31	3.97%
Italy	24	3.08%

Notes: TP=total number of publications

The most productive authors are presented in Table 8. Rabbani, M.R. from Bahrain, became the most productive author in FinTech with eight publications. Next is Reyes-Mercado, P. with 7 (0.79%) publications, followed by Arner, D.W. from Hong Kong, with 6 (0.69%) publications on FinTech. Both Fernando, E. and Khan, S. also are reported to contribute 6 ().59%) publications on FinTech.

Table 8. Most Productive Authors

Author Name	Total Publication	Percentage (N=1011)	Affiliation	Country
Rabbani, M.R.	7	0.90%	University of Bahrain, Sakhir	Bahrain
Reyes-Mercado, P.	7	0.90%	Universidad Anáhuac México	Mexico
Arner, D.W.	6	0.77%	The University of Hong Kong, Pokfulam	Hong Kong
Martin, P.L.	6	0.77%	unknown	unknown
Khan, S.	5	0.64%	University College of Bahrain	Bahrain
Okoli, T.T.	5	0.64%		
Schwienbacher, A.	5	0.64%	SKEMA Business School, Lille	France
Wonglimpiyarat, J.	5	0.64%		
Wójcik, D.	5	0.64%		

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Al-Dmour, A.	4	0.51%		
Rabbani, M.R.	7	0.90%	University of Bahrain, Sakhir	Bahrain

Notes: TP=total number of publications

The most active source title is also further retrieved, and the results are presented in Table 9. The list is based on a minimum of seven (7) total publications from the source. ACM International Conference Proceeding Series is the most active source title that shows 18 (1.78%) publications on FinTech. Sustainability Switzerland has 15 publications on FinTech, contributing 1.48% of 1,011 documents, followed by the Economist United Kingdom with 14 (1.38%) publications on FinTech.

Table 9. Most Active Source Title

Source Title	**Total Publication**	**Percentage (N=1011)**
ACM International Conference Proceeding Series	18	1.78%
Sustainability Switzerland	15	1.48%
Economist United Kingdom	14	1.38%
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	13	1.29%
Lecture Notes In Networks And Systems	13	1.29%
E3s Web of Conferences	12	1.19%
Financial Innovation	11	1.09%
International Journal of Advanced Science And Technology	11	1.09%
Journal of Payments Strategy And Systems	10	0.99%
Advances In Intelligent Systems And Computing	9	0.89%
Routledge Handbook of Financial Technology And Law	9	0.89%
Impact of Financial Technology FinTech on Islamic Finance And Financial Stability	8	0.79%
Perspectives In Law Business And Innovation	8	0.79%
Routledge Handbook of FinTech	8	0.79%
Studies In Computational Intelligence	8	0.79%
Cutter Business Technology Journal	7	0.69%

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Industrial Management And Data Systems	7	0.69%
IOP Conference Series Materials Science And Engineering	7	0.69%
Journal of Advanced Research In Dynamical And Control Systems	7	0.69%
Journal of Open Innovation Technology Market And Complexity	7	0.69%
Palgrave Studies In Democracy Innovation And Entrepreneurship For Growth	7	0.69%

Notes: TP=total number of publications; TC=total citations

4.3 Citation Network Analysis

This section discusses our third RQ *(RQ3: Which are the most influential articles on FinTech?).* This study also conducted the citation analysis using citation metrics via Harzing Publish or Perish software. On top of that, this study also uses the bibliometric analysis to map the citation based on the publication by researcher/author, the most cited publication, citation by countries, and co-authorship among the researchers/authors in publication of articles on FinTech.

Table 10 shows the citation metrics of the 1,011 documents gathered from Scopus. There are 6,055 citations of articles on FinTech from 1984 to 2021. In the previous section, it has to be indicated here that this study states the publication year is 38, inclusive of the year 2022, for which one of the articles will be published in the year 2022. However, for the citation analysis, the number of years is 37, i.e., 1984 to 2021, as the citation is based on the articles published in Scopus as of 2021. It is reported that the average citation per year is 163 citations. The average citation per paper/article is six, and an average of 3 citations of the author.

Table 10. Citations Metrics

Metrics	Data
Number of Papers	1011
Citations	6055
Citation Years	37
Cites/Year	163.65
Cites/Paper	5.99
Authors/Paper	2.58
h index	37
g index	60

Using bibliometric analysis, this study managed to map the most citation of the article/document based on researcher/author. The network visualisation map is retrieved by setting the minimum citation number of an article/document at 1. This excludes the article/document with zero (0) citations.

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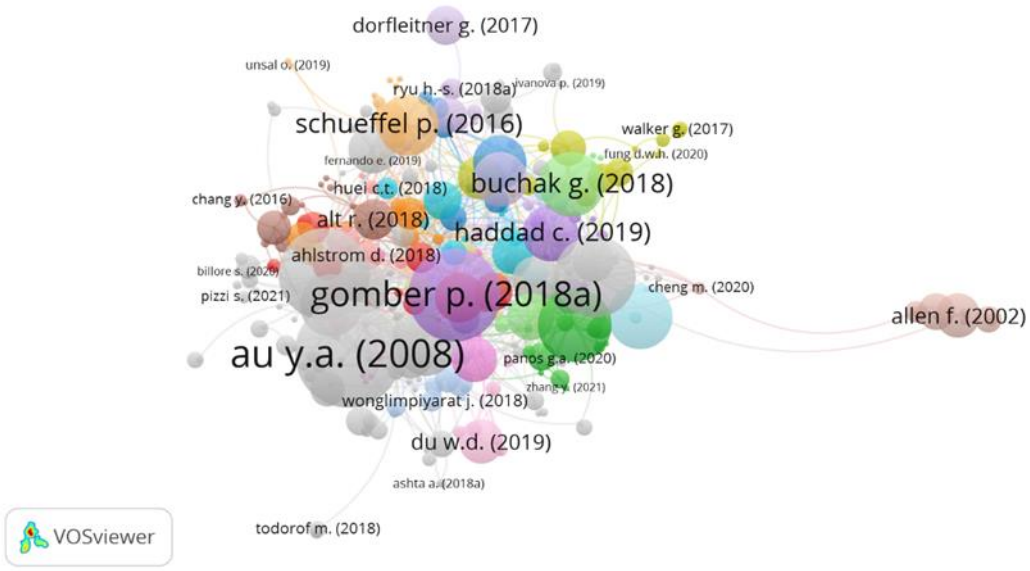

Figure 4. Network visualisation map of the citation by documents

Minimum number of citations of a document = 1

Figure 4 shows the network visualisation map of the citation by articles/documents relating to FinTech. From the map, it is obviously seen that the most cited articles/documents on FinTech are the articles/documents written by Au, Y.A. that was published in the year 2008. This is based on the largest circle that appeared on the map. The following article/document always being cited are the articles/documents written by Gomber, P., published in 2018.

The citation map by article/documents based on researcher/author retrieved from Vosviewer is further proven and explained by the frequencies using Ms Excel. The results of the most cited articles are based on the authors shown in Table 11. The article by Au, Y.A., and Kauffman, R.J. (2008) is the most cited article/document with 243 citations, marking 19 citations per year. The second article/document that is always cited is the article/document by Gomber et al. (2018), with 195 citations and an average citation per year is 65.

Table 11. Top 20 Highly cited articles

No.	Authors	Title	Year	Cites	Cites per year
1	Y.A. Au, R.J. Kauffman	The economics of mobile payments: Understanding stakeholder issues for an emerging financial technology application	2008	243	18.69
2	P. Gomber, R.J. Kauffman, C. Parker, B.W. Weber	On the FinTech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services	2018	195	65
3	I. Lee, Y.J. Shin	FinTech: Ecosystem, business models, investment decisions, and challenges	2018	189	63

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4	P. Gomber, J.-A. Koch, M. Siering	Digital Finance and FinTech: current research and future research directions	2017	158	39.5
5	D. Gabor, S. Brooks	The digital revolution in financial inclusion: international development in the FinTech era	2017	134	33.5
6	M.E. Greiner, H. Wang	Building consumer-to-consumer trust in E-finance market-places: An empirical analysis	2010	107	9.73
7	G. Buchak, G. Matvos, T. Piskorski, A. Seru	FinTech, regulatory arbitrage, and the rise of shadow banks	2018	106	35.33
8	K. Gai, M. Qiu, X. Sun	A survey on FinTech	2018	102	34
9	Q.K. Nguyen	Blockchain-A Financial Technology for Future Sustainable Development	2016	99	19.8
10	P. Schueffel	Taming the beast: A scientific definition of FinTech	2016	96	19.2
11	C. Leong, B. Tan, X. Xiao, F.T.C. Tan, Y. Sun	Nurturing a FinTech ecosystem: The case of a youth microloan start-up in China	2017	91	22.75
12	C. Haddad, L. Hornuf	The emergence of the global FinTech market: economic and technological determinants	2019	83	41.5
13	T. Puschmann	FinTech	2017	80	20
14	D.W. Arner, J. Barberis, R.P. Buckley	FinTech, regTech, and the reconceptualisation of financial regulation	20	78	19.5

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			17		
15	Y. Shim, D.-H. Shin	Analysing China's FinTech Industry from the Perspective of Actor-Network Theory	2016	76	15.2
16	I. Anagnostopoulos	FinTech and regtech: Impact on regulators and banks	2018	69	23
17	Y. Kim, J. Choi, Y.-J. Park, J. Yeon	The adoption of mobile payment services for FinTech	2016	67	13.4
18	A.V. Thakor	FinTech and banking: What do we know?	2020	62	62
19	M.A. Chen, Q. Wu, B. Yang	How Valuable Is FinTech Innovation?	2019	62	31
20	C.W. Cai	Disruption of financial intermediation by FinTech: a re-view on crowdfunding and blockchain	2018	61	20.33

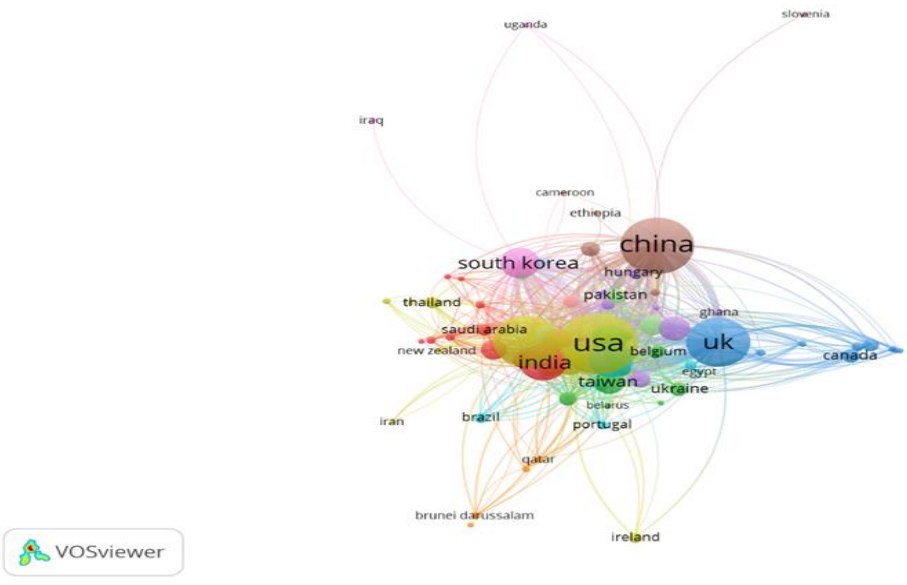

Figure 5. Network visualisation map of the citation by countries

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Note: Minimum number of documents of an author = 1; Minimum number of citations of an author = 1

Figure 5 shows the network visualisation map of the citation based on the author's country. The most cited articles/documents based on the author's country appeared to be the enormous circle on the visual map. The circles represent the United States of America (USA), China, and the United Kingdom (UK) are among the most prominent circles, thus showing that the articles/documents from these three countries have been the most cited in the publication. The visual map is further explained by referring to the results presented in Table 12. The USA has the highest number of publications, i.e., 139 (13.75%) publications, next is China (123:12.17%), followed by Indonesia (107:10.58%), United Kingdom (97:9.59%), and India (57:5.64%).

Table 12: Countries with Highest Publications

Country	**Total Publications**	**Percentage (N=1011)**
United States	139	13.75%
China	123	12.17%
Indonesia	107	10.58%
United Kingdom	97	9.59%
India	57	5.64%
Australia	52	5.14%
South Korea	45	4.45%
Germany	41	4.06%
Russian Federation	37	3.66%
Malaysia	31	3.07%

4.4 Authorship Analysis

To answer RQ4 *(RQ4: What are the authorship patterns of the publication in FinTech?)*, Table 13 shows the number of authors who collaborated on an article/document. 265 (26.21%) of 1,011 articles on FinTech were written by one researcher/author. 261 (25.82%) articles/documents collaborated with two (2) authors. 223 (22.06%) articles/documents have three (3) authors, followed by 142 (14.05%) articles/documents with four (4) authors. However, the authors' information is unavailable in 22 (2.18%) articles/documents and cannot be obtained from Scopus.

Table 13. Number of Author(s) per document

Author Count	Frequency	Percentage (N=1011)
1	265	26.21
2	261	25.82
3	223	22.06

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4	142	14.05
5	50	4.95
6	25	2.47
7	12	1.19
8	5	0.49
9	2	0.20
10	3	0.30
11	1	0.10
0	22	2.18
Grand Total	1011	100.00

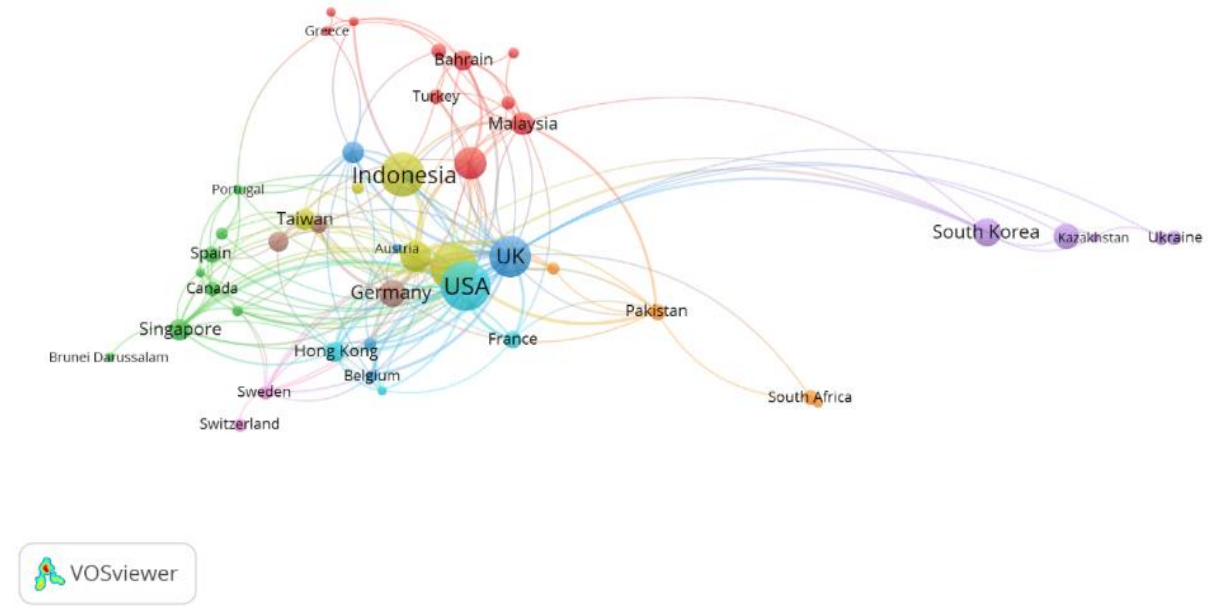

Figure 6. Network visualisation map of the co-authorship (country)

Note: Unit of analysis = Countries; Counting method: Full counting; Minimum number of documents of a country = 1; Minimum number of citations of a country =1

Figure 6 shows the network visualisation map of the co-authorship retrieved from VOSViewer. The analysis found nine (9) clusters with 189 links. It shows that most collaboration among authors was from the United States of America (USA), the United Kingdom (UK), and Indonesia.

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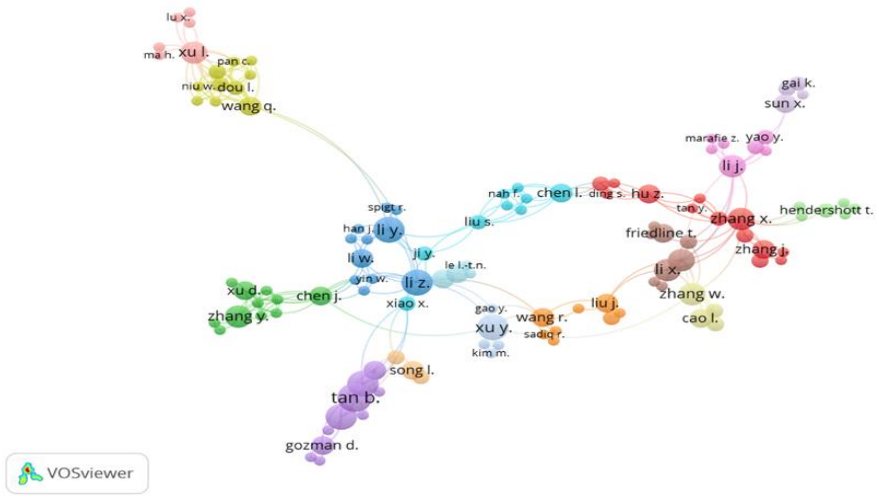

Figure 7. Network visualisation map of the co-authorship (authors)

Note: Unit of analysis = Authors; Counting method: Fractional counting; Minimum number of documents of an author = 1; Minimum number of citations of an author = 1

Figure 7 shows the network visualisation map of the co-authorship. This shows the collaboration between authors in publications on FinTech. The authors in each cluster usually collaborate and cite each other publications. There are 13 clusters shown in the network, which are presented in 13 different colours.

4.7 Keyword and co-occurrences analysis

To answer RQ5 (*RQ5: Which themes of FinTech are most popular among researchers?*), we utilised the VOSViewer software and determined the frequent themes used in the publication related to FinTech. Based on 1,011 data obtained from Scopus, we examine the co-occurrence based on the authors' keywords, the co-occurrence of title and abstract fields, and the co-occurrence of title fields. The co-occurrence of the author keywords network map is generated using the full counting. We set the minimum number of occurrences of a keyword at 1

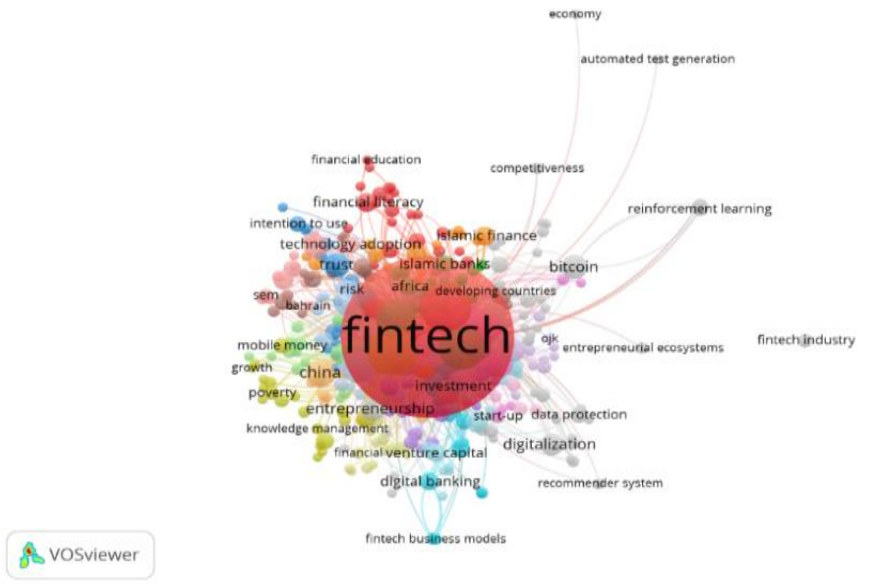

Figure 8. Network visualisation map of the co-occurrence of author keywords

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Based on the network visualisation map in Figure 8, the keyword most used by the author is FinTech. The biggest red circle indicates the most keyword used in a publication related to FinTech. Table 14 also shows the top keywords are FinTech (359:35.51%), FinTech (169:16.72%) and Financial Technology (107:10.58%). It is important to know that the mapping (Figure 8) retrieved using VOSviewer to map the most keyword used by the authors has grouped the three keywords i.e., FinTech, FinTech, and Financial Technology, as FinTech.

Table 14. Top Keywords

Keywords	**TP**	**%**
FinTech	359	35.51%
FinTech	169	16.72%
Financial Technology	107	10.58%
Finance	106	10.48%
Financial Service	60	5.93%
Blockchain	57	5.64%
Innovation	55	5.44%
Banking	53	5.24%
Financial Inclusion	45	4.45%
Artificial Intelligence	42	4.15%

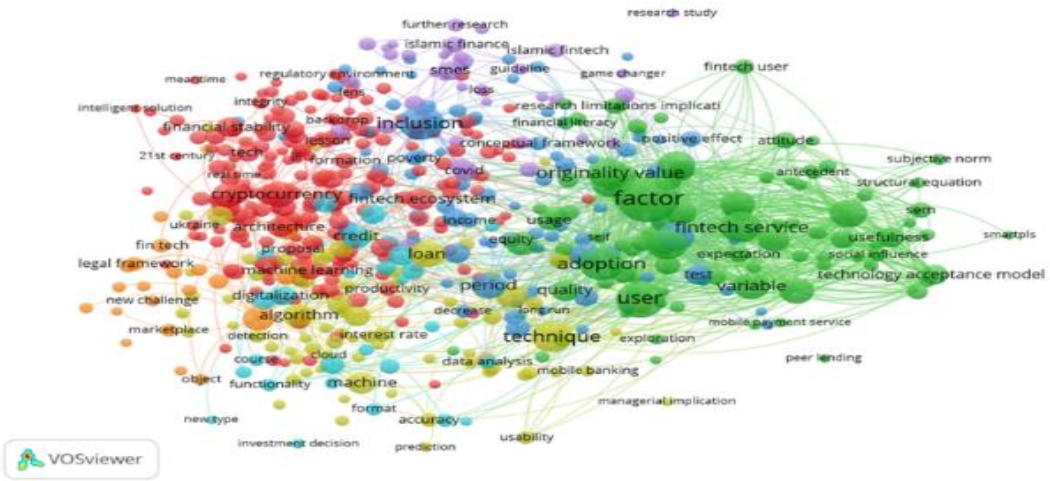

Figure 9. VOSviewer visualisation of a term co-occurrence network based on title and abstract fields (Binary Counting)

Figure 9 shows the visual of the co-occurrence network based on the title and abstract used in the articles/documents. The co-occurrence is based on title, and abstract fields counted using binary counting. By choosing the minimum number of occurrences of the term as 10, out of 113,823 terms, 4,806 meet the threshold. Only 60% (by default) of the threshold are considered the most relevant terms, i.e. 2,884. The same colour that presents the titles and abstract terms linked. This shows that the title and abstract keywords are grouped with the

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same colour, are closely related and co-occur together most of the time. There are four (6) clusters that appear clearly on the visual map. The green cluster is about FinTech service, the yellow cluster is about techniques used in FinTech, the red cluster is about the FinTech ecosystem, the light blue cluster is about digitalisation, the orange cluster is big data, and the purple cluster is about the application of FinTech such as Islamic FinTech and FinTech used in SMEs.

DISCUSSION AND CONCLUSION

The goal of the present article was to highlight a few research questions. We have addressed the following research questions in this current article: RQ1: What is the current state of FinTech publication? RQ2: What are the most productive contributors to FinTech research? RQ3: Which are the most influential articles on FinTech? RQ4: What are the authorship patterns of the publication in FinTech? RQ5: Which themes of FinTech are most popular among researchers?

According to our findings, FinTech research is convergent across multiple research areas. However, the most prominent area focuses on business, management, and accounting. From 2016 to 2020, the number of publications is increased. 2020 has the most publications, with 288 papers published in the Scopus database. Rabbani, M.R. from Bahrain is the most well-known FinTech scholar, having published eight papers. Bina Nusantara University in Indonesia is the most influential institution contributing to FinTech publications over the last 38 years. However, if we rank countries, Indonesia comes in third place, trailing only the United States of America (USA) and China.

The most popular topic is a mobile payment and financial service transformation. It is widely assumed that the most popular topic of discussion in FinTech is related to the transformation of the banking industry. The increased use of mobile devices increases the demand for financial technology applications developed during COVID-19. The increment corresponds to FinTech 3.5, demonstrating a high reliance on smartphones daily. The findings also show that the total number of citations increased significantly between 2016 and 2019.

FinTech has been of primary interest for decades. Our findings advance our understanding of the trend in FinTech topic publication by analysing the trend for 38 years. Regardless of the obvious significance of this work in revealing the edge of FinTech research, some limitations are unavoidable. Notably, the preceding FinTech research repertory is limited to those solely indexed in the Scopus database, perhaps the most extensive academic research collection. As a result, despite their potential importance, papers from sources other than Scopus were excluded from the analysis. However, these constraints open exciting avenues and solutions for future research on the same subject. It would be useful for future studies to include additional methodological tools, such as multiple combination analyses and databases and bibliometric analysis. Future research may extend this work by adding the coverage of the analysis by adding the systematic literature review of the analysis. Researchers can further analyse the issues obstructing FinTech research and what more is to be done in this area.

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