Mapping of Methodological Research Gaps on Financial Technology Study: Bibliometric Analysis

Shahrul Nizam Bin Salahudin [1], Yosy Arisandy [2*], Yosza Bin Dasril [1]

[1] University Tun Husein Onn Johor, Malaysia.
[2] Fatmawati Sukarno State Islamic University, Bengkulu 38211, Indonesia
*Corresponding author, E-mail address: **yosyarisandy@mail.uinfasbengkulu.ac.id**

ARTICLE INFO	ABSTRACT
	This study aims to map the research methodology gaps, in the field of Financial Technology (Fin Tech) and propose some trending topic opportunities for the future. Data collection uses the keyword "Financial Technology" applied to article titles, abstracts, and keywords from the Elsevier Scopus database from early 2014 to April 2023. We map academic contributions and research gaps, focused on the most influential research streams and trends by conducting bibliometric analysis with the help of R software studio, then propose some themes for future research. The results show that there has been an increase in the number of proceedings papers and journal articles on Financia technology. Research on Fin-Tech is dominated by quantitative methods, compared to qualitative and hybrid methods, the use of analytical tools such as Artificial Intelligence, machine learning, and Generalized Moment Methods has increased in the scope of statistical methods. Quantitative research is dominated by China and Indonesia. The UK produces the most research on qualitative methods, while mixed-method research is highly developed in the UK, the United States, and South Africa. The results of this study identify the most influential articles on fintech, a map that is different from previous studies; visualize focus areas and trends; and determine areas for further research. These findings will help academics focus their research, based on under-researched scientific areas in this heterogeneous niche.

1. Introduction

In the twenty-first century, financial technology (fintech) has been further computerized through the mobile wallet, payment apps, tech for wealth and financial planning, and crowdfunding platforms for alternative financing opportunities (Huei et al., 2018). The field of fintech is currently experiencing an increase in research interest, making it a compelling area of study. A total of 938 research documents, (Table 1) pertaining to fintech have been identified through a Scopus search spanning from 2014 to 2023. The quantity of research on financial technology has exhibited an upward trend over time describe on Table 1 and Figure. 1.

Table 1. Main Information

| Description	Results
Main Information About Data	
Timespan	2014:2023
Sources (Journals, Books, etc)	555
Documents	938
Annual Growth Rate %	63.17
Document Average Age	2.29
Average citations per doc	10.05
References	41776
Document Contents	
Keywords Plus (ID)	2428
Author's Keywords (DE)	2271
Authors	
Authors	2405
Authors of single-authored docs	156
Authors Collaboration	
Single-authored docs	171
Co-Authors per Doc	3
International co-authorships %	25.8
Document Types	
article	602
book chapter	92
conference paper	244
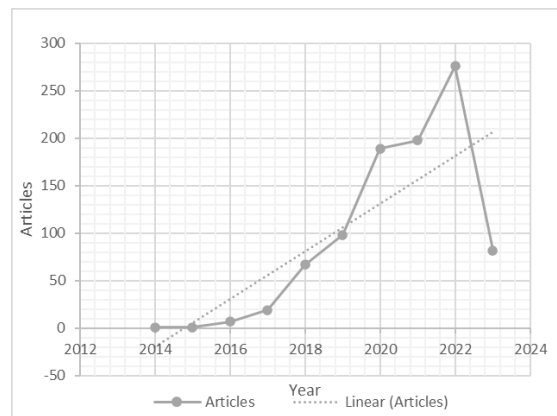
Figure. 1. Annual Articles Production

Cloud computing, big data, the internet of things, and social computing have been emphasized in finance. This advancement supports the existing company structure and enables the financial service industry adopt new processes, systems, products, and services to improve efficiency(Mercurius Broto Legowo, Steph Subanidja, 2022; Puschmann, 2017). Current trends in financial technology encompass the classification and evaluation of diverse artificial intelligence technologies predicated on their accessibility and level of development(Martínez-Plumed et al., 2021). Moreover, it offers research on topics such as the contextualization of users' facilities and their experience with the web interface within the financial service sector (Hornuf et al., 2021; Rahmanto, 2022; Wang et al., 2021), machine learning tools in electronic finance market trading (Maknickienė et

al., 2020; Putra et al., 2019; Salman, 2020), and advanced modelling for stock movements (Wan & Yang, 2019) and settlement models with renewable energy that are based on blockchain technology (Abdeldayem & Al Dulaimi, 2020; Das, 2019). Furthermore, it is imperative to ascertain the primary contributors in the domains of computer science, social science, and environmental science, along with the prospective research avenues and topics that will enable scholars to make noteworthy advancements in the field (Nasir et al., 2021).

One of the foremost challenges in the field of research pertains to the formulation of a research agenda and the subsequent construction of research based on the identification of a research gap (Miles, 2017). Miles (2017) introduced a novel framework that integrates two pre-existing models, comprising seven fundamental research gaps that have been renamed: Evidence gap, knowledge gap, Practical-Knowledge Conflict Gap, Methodological Gap, Empirical Gap, Theoretical Gap, Population Gap. However, this research only focuses on the Method and research design Gap or Methodological Gap.

Methodological gaps involve study outcomes conflicting with methodology. This gap addresses issues with existing study methodologies and offers a new area of investigation. If specific study topics have been mostly studied using one approach, it may be beneficial to change methods (Miles, 2017). Method and research design divide to qualitative, quantitative, and mixed methods research (Baškarada & Koronios, 2018). The methodology employed in research serves as a systematic approach to effectively address the research problem at hand. The discipline can be conceptualized as a scientific inquiry into the methodology of conducting research (Patel & Patel, 2019).

2. Method

The general science mapping workflow was described by Börner, Chen, and Boyack (2003). Cobo, Lopez-Herrera, Herrera-Viedma, and Herrera, (2011a) compared science mapping software tools using a similar workflow (Dasril et al., 2023). A standard workflow consists of five stages (Zupic &ˇCater, 2015): Study design, data collection, data analysis, data visualization and Interpretation.
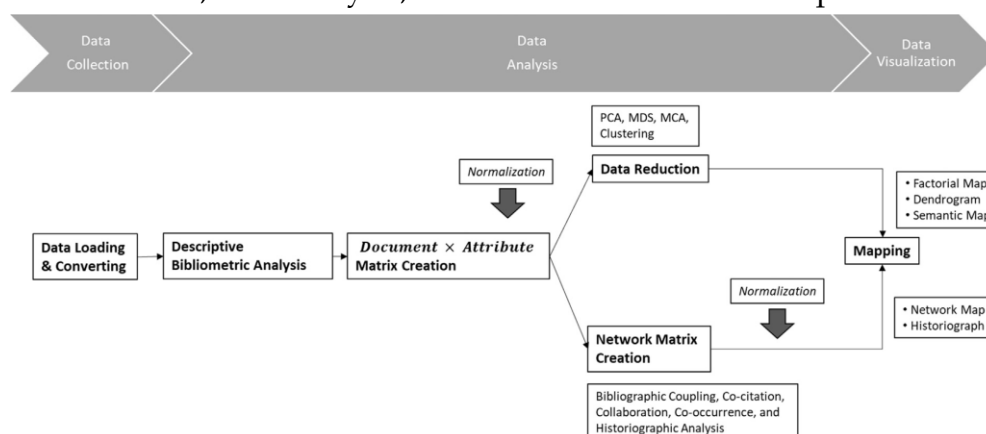

Figure.2. Research mapping workflow (Aria & Cuccurullo, 2017)

Sample selection process

The data collection process comprises three sub-stages. Prioritize data retrieval. Scopus is a bibliographic database that conducts research on those mentioned databases. In the second sub-stage, it is imperative for scholars to undertake the task of loading and converting data for bibliometric tools. The process of data cleansing has been completed. The pre-processing stage involves identifying duplicate entries and typographical errors. Bibliographic citations have the potential to encompass multiple iterations of a given publication and diverse authorship attributions, notwithstanding the generally reliable nature of bibliometric metric. The utilization of surname and initials as a means of author abbreviation may pose challenges in cases where authors share common names. The selection of cited journals may exhibit variability. Multiple editions may be referenced.

3. Results and Discussion

Bibliometric Analysis

Co-occurrence network

By treating each keyword as a node and each occurrence of a pair of words as a connection between those words, a network of keyword co-occurrences is formed (see Fig. 3). The weight of the link connecting these keywords is determined by the frequency with which a pair of terms occurs together. This kind of network construction results in a weighted network. The co-occurrence network, also known as a semantic network, is a text-analysis technique that includes a visual representation of possible connections between keywords.

Figure 3. Co-occurrence network
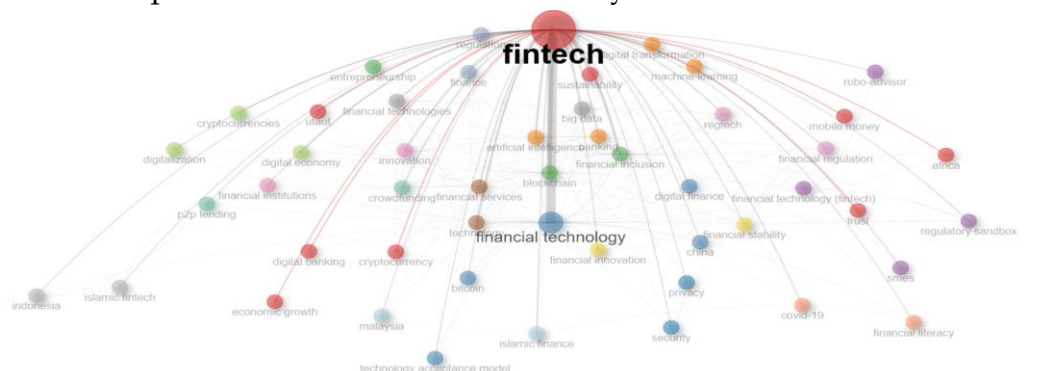
The connection between fintech keywords shows their relevance in the research that has been done. If there is no link between several keywords in the co-occurrence network, this shows the potential to be developed into a novelty and gap in research. In Fig.3. there are several keywords that are not yet connected and could be the development of further fintech research, for example between technology acceptance model and Islamic finance, financial inclusion with investment, digital transformation with SMEs (Small and Medium enterprises) and others.

Country Scientific Production

Research on fintech is very interesting, several countries are concerned with conducting research in the field of Fintech, including China, Indonesia, USA, UK, India, Malaysia, Australia, Bahrain, Germany, and Jordan are in the top 10 countries that research fintech (fig. 3). China has the highest ranking in research production regarding fintech with 354 research. Quantitative research is dominated by China and Indonesia, the United Kingdom produces the most research on qualitative methods, while research with mixed methods is highly developed in the United Kingdom, the United States and South Africa.
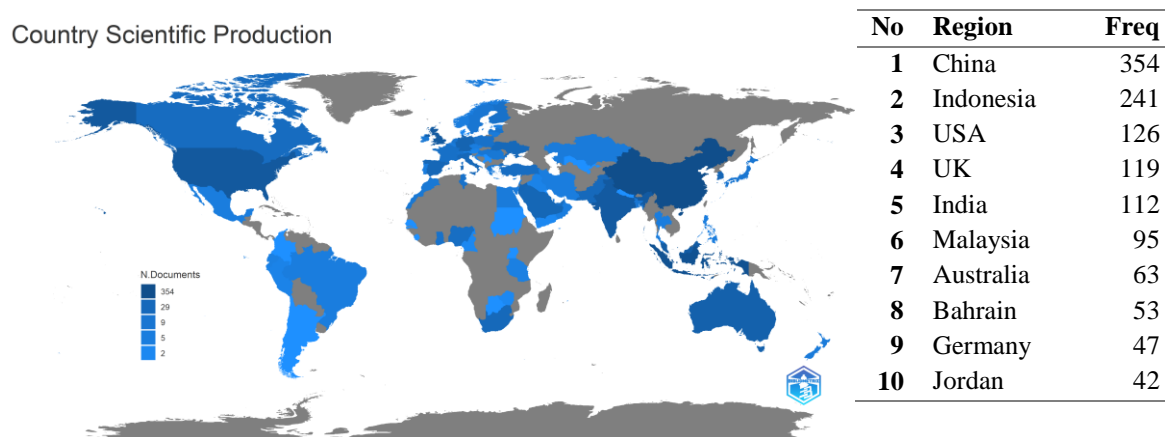

No	Region	Freq
1	China	354
2	Indonesia	241
3	USA	126
4	UK	119
5	India	112
6	Malaysia	95
7	Australia	63
8	Bahrain	53
9	Germany	47
10	Jordan	42

Figure 4. Country Scientific Production Mapping

Thematic Map

The thematic map is provided in Figure 6. The axis is formulated based on density and centrality. The thematic map has been divided into four quadrants, namely the emerging or declining themes, motor themes, basic themes, and niche themes. The horizontal and vertical axes provided in the figure as dotted lines divide the thematic map into four quadrants. The basic themes comprised with author keyword Fintech, financial inclusion, cryptocurrency, bit coin, intention to use, financial literacy, e-wallet, Africa, covid-19, artificial intelligence, machine learning, big data, financial development, Indonesia and Islamic fintech. Financial stability, financial innovation, mobile payment, startups, and emerging markets were found to be in between the two quadrants, namely basic and motor themes. The relevant clusters observed in the quadrant regarding niche themes were banking industry, fintech adoption, Saudi Arabia, competitiveness, payment system, digital wallet, fintech lending, open banking, financial system, continuance intention and service quality. Again, it was observed that the cluster sustainability, sustainable development, GMM and digital payment were located in between basic themes and emerging or declining themes. An interesting observation about the motor themes was that all clusters in this quadrant were sharing their space with other quadrant-based themes. The emerging or declining themes comprised fintech industry, fintech development, entrepreneurial finance digital payment and internet of things.

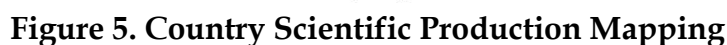**Figure 5. Country Scientific Production Mapping**

Thematic Evaluation

Figure 7. represents the evolution of fintech research from 2014 to April 2023, utilizing author keywords, inclusion index weighted by word occurrences, and the walk trap clustering algorithm to analyses various fields. Thematic evolution guided the identification of conceptual sub-domains. Hence, the figures mentioned above played a crucial role in facilitating the cartographic representation of the relevant areas of study, including the associated subtopics or subdisciplines (Sengupta & Vaish, 2023). In 2023, the prevailing research subtopics were identified as fintech, artificial intelligence, digital transformation, e-wallet, fintech adoption, peer-to-peer lending, sustainability, fintech services, China, mobile banking, economic growth, and the Internet of Things (IoT).

Figure 6. Thematic Evaluation

Factorial Mapping

The conceptual Structure function in the bibliometrix R-package does multiple correspondence analysis (MCA) to create a conceptual structure of the field and K-means clustering to locate document groupings that express common concepts. Exploratory multivariate categorical data analysis with MCA is graphical and numerical. MCA homogeneity analyses an indicator matrix to create a low-

dimensional Euclidean representation of the original data. MCA is used in co-word analysis. [CS <- conceptual Structure(M, field="ID", min Degree=5, k.max=5, stemming=FALSE), label size=5]. Point placements are used to understand the results (Aria & Cuccurullo, 2017).

Figure. 7 presented illustrates a two-dimensional graph that has been constructed using the topic words found within the Author Keywords of the papers that have been cited. A technique known as multiple correspondence analysis can be employed to condense large datasets containing multiple variables into a lower-dimensional space. This results in the creation of a two-dimensional map, with dimensions labelled as Dim 1 and Dim 2. The words located in close proximity to the central point of the group are those that have garnered significant attention in recent years, including financial regulation, security, bitcoin, privacy, and Islamic fintech. Conversely, those located near the edge of the map are topics that have received less research attention or have been subsumed into other topics, such as sustainability and peer-to-peer lending.
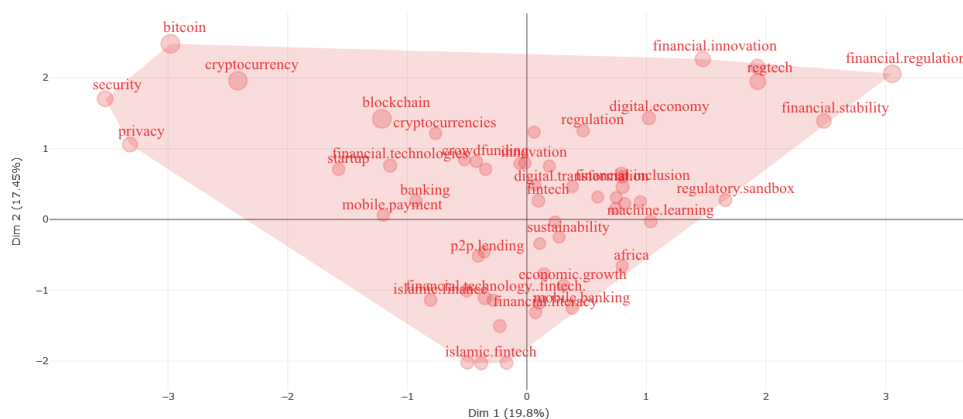

Figure 7. Bibliometric conceptual structure map-factorial analysis
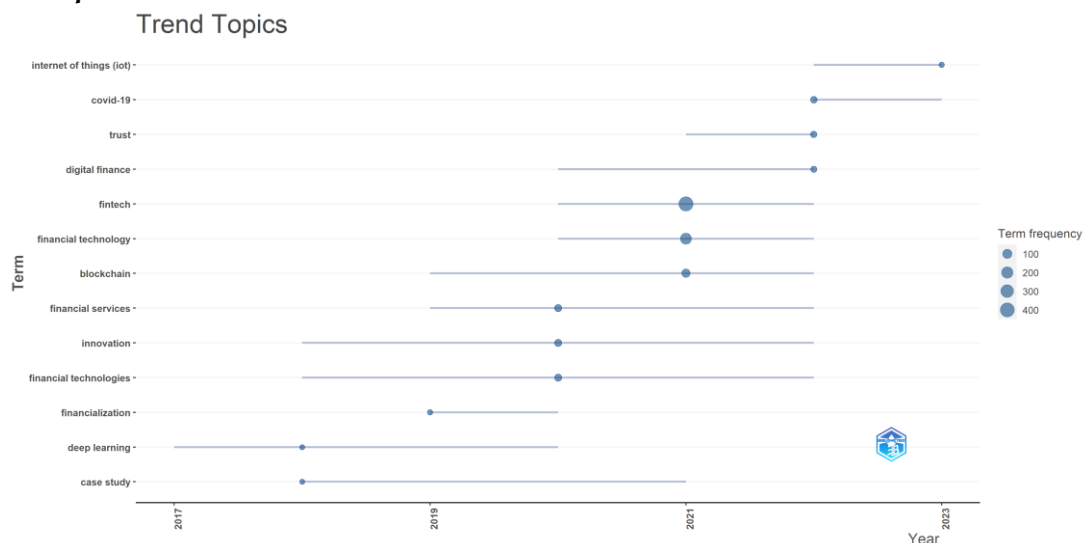
Trend Topics

Figure 8. Trend Topics

Figure 9 presents a range of intriguing research topics, encompassing themes such as trust, digital finance, blockchain, innovation, and financial services. The usage of the keywords "Internet of Things (IoT)" and "COVID-19" are projected to be prominent trend topics in 2023. This research defines the gap in methodology into three distinct types: qualitative, quantitative, and mixed methods.

Table 2. Research Gap in Methodology

Source	Method	Source	Method
(Zook & Blankenship, 2018)	Mix Method	(Hendershott et al., 2021)	Mix Method
(Anagnostopoulos, 2018)	Mix Method	(Abdeldayem, M., Aldulaimi, 2021)	Quantitative
(Martínez-Climent et al., 2018)	Mix Method	(Kharisma, 2021)	Qualitative
(Gimpel et al., 2018)	Qualitative	(Ali et al., 2021)	Quantitative
(Kshetri & Voas, 2018)	Qualitative	(Broby, 2021)	Qualitative
(Gatteschi et al., 2018)	Quantitative	(Almulla & Aljughaiman, 2021)	Quantitative
(Gozman et al., 2018)	Quantitative	(Cai et al., 2021)	Quantitative
(Ryu, 2018)	Quantitative	(Coffie et al., 2021)	Mix Method
(Stewart & Jürjens, 2018)	Quantitative	(T, 2021)	Mix Method
(Haddad & Hornuf, 2019)	Mix Method	(Yao et al., 2021)	Quantitative
(Belanche et al., 2019)	Qualitative	(Demir et al., 2022)	Quantitative
(Milian et al., 2019)	Quantitative	(J. Zhao et al., 2022)	Quantitative
(Du et al., 2019)	Quantitative	(Murinde et al., 2022)	Quantitative
(Mao et al., 2019)	Quantitative	(Lagna & Ravishankar, 2022)	Qualitative
(Lim et al., 2019)	Quantitative	(Soni et al., 2022)	Quantitative
(J. Lee et al., 2019)	Quantitative	(Usman et al., 2022)	Quantitative
(Anshari et al., 2019)	Quantitative	(Ye et al., 2022)	Quantitative
(Q. Zhao et al., 2019)	Quantitative	(H. Chen & Yoon, 2022)	Quantitative
(Bernards & Campbell-Verduyn, 2019)	Quantitative	(Berman et al., 2022)	Mix Method
(Senyo & Osabutey, 2020)	Mix Method	(Brown & Piroska, 2022)	Qualitative
(Zetzsche et al., 2020)	Qualitative	(Rahman, M., Ming, T.H., Baigh, T.A., Sarker, 2022)	Mix Method
(Chang et al., 2020)	Qualitative	(Abdeldayem, M.M., Aldulaimi, 2022)	Quantitative
(Phan et al., 2020)	Qualitative	(X. Chen et al., 2022)	Quantitative
(Wójcik & Ioannou, 2020)	Qualitative	(A. A. Setiawan et al., 2022)	Quantitative
(Y. Chen & Bellavitis, 2020)	Quantitative	(Hasan et al., 2022)	Quantitative
(Jünger & Mietzner, 2020)	Quantitative	(Senyo et al., 2022)	Qualitative
(Arner et al., 2020)	Quantitative	(Widhyastana & Rachmawati, 2022)	Quantitative
(Demirgüç-Kunt et al., 2020)	Quantitative	(Grassa, R., Sarea, A., El-Halaby, S., Damak, 2022)	Quantitative
(Palmié et al., 2020)	Quantitative	(Herdinata & Pranatasari, 2022)	Mix Method
(Kou et al., 2021)	Quantitative	(Banna et al., 2022)	Quantitative
(C. C. Lee et al., 2021)	Quantitative	(Al-Khowarizmi, A., Syah, R., Elveny, 2022)	Qualitative
(Barbu et al., 2021)	Quantitative	(Laksamana et al., 2022)	Quantitative
(Wang et al., 2021)	Quantitative	(Maiti & Ghosh, 2023)	Quantitative
(Sheng, 2021)	Quantitative	(Ren et al., 2023)	Quantitative
(Ozili, 2021)	Qualitative	(Najaf et al., 2023)	Quantitative
(Le et al., 2021)	Quantitative	(Festa et al., 2023)	Quantitive
(Abbasi et al., 2021)	Quantitative	(Munusamy A;Adhikari M, 2023)	Quantitative
(Lai & Samers, 2021)	Mix Method	(Tyagi & Boyang, 2021)	Quantitative
(Croutzet & Dabbous, 2021)	Quantitative		

Source	Method	Source	Method
(Hsu et al., 2023)	Quantitative	(Arora et al., 2023)	Mix Method
(Junarsin, E., Hanafi, M.M., Iman, N., Arief, U., Naufa, A.M., Mhastanti, L., Kristanto, 2023)	Quantitative	(Coffie & Hongjiang, 2023)	Quantitative
		(C. T. Lee & Pan, 2023)	Quantitative
(Khuwaja et al., 2023)	Quantitative	(Yudaruddin, 2023)	Quantitative
(Sadiq et al., 2023)	Quantitative	(McCallum & Aziakpono, 2023)	Mix Method
(JC, 2023)	Quantitative	(Nguyen et al., 2023)	Quantitative
(Setiawan et al., 2023)	Quantitative		

Figure 9. Research Methodology Gap Mapping

The tabulated data indicates that quantitative research methodology is consistently favoured over qualitative and mixed methods in terms of popularity across the years. In comparison to the quantitative method, the Mix method is more commonly utilized. The use of methods such as Artificial Intelligence, machine learning and the Common Moment Method is increasing in statistical methods.
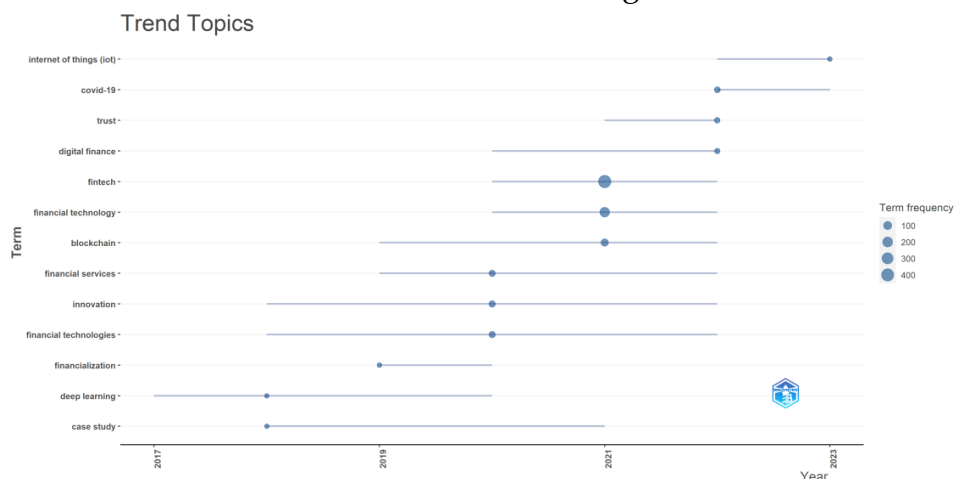

Figure 10. Trend Topics

Figure 9 presents a range of intriguing research topics, encompassing themes such as trust, digital finance, blockchain, innovation, and financial services. The usage of the keywords "Internet of Things (IoT)" and "COVID-19" are projected to be prominent trend topics in 2023.

This research defines the gap in methodology into three distinct types: qualitative, quantitative, and mixed methods .

Future Research

In the context of the Gap methodology, there exist various recommendations that could be employed for forthcoming investigations, specifically.

1. Qualitative analysis through interviews or surveys can be useful in offering in-depth analysis and case studies. In collecting qualitative research data using a combination of participant observation strategies, structured interviews and semi-structured interviews. While qualitative research designs can be developed using several options including longitudinal case study designs, science experiment designs, thinking designs as research paradigms and comparative case studies.

2. Future research endeavours may utilize quantitative methodologies that use both descriptive and empirical evidence, obtained through various means such as survey questionnaires, cross-sectional surveys, longitudinal cross-country surveys, structured interviews, and longitudinal case studies. Additionally, it may be beneficial to employ a genuine secondary dataset that measures the development of FinTech, as soon as such data becomes available for more extended time frames. It is recommended to replicate certain empirical exercises across various regions and explanatory variables.

3. Moving beyond methodological to establish new specialities to examine financial inclusion and poverty reduction while addressing (developing) intersectionality, including new forms of fraud, debt, and personal and business bankruptcy. Financial inclusion risks, politics and political economy of financial inclusion, effects on macro financial stability, optimal levels of financial inclusion, regional economic blocs, financial inclusion regulation, and other financial inclusion interventions. Given the importance of stakeholder network interaction in fintech-led financial inclusion, mixed methods research is essential to explore these actors.

4. Conclusion

Bibliometric analysis by Co- occurrence finds there are several keywords that are not yet connected and could be the development of further fintech research, for example between technology acceptance model and Islamic finance, financial inclusion with investment, digital transformation with SMEs. China is the country that conducts the most research on Fintech. on a Thematic Map the motor theme or driving topic for Fintech research are mobile money, lending, payment system, robo-advisor, UTAUT, attitude, banking, technology, startup, supply chain finance and technology acceptance model. The emerging markets, startups, mobile payments, financial innovation, financial stability, and digital economy are among the titles that are gaining increasing interest for development, positioned between the basic themes and the motor themes. Factorial mapping has gained considerable attention in various fields such as financial regulation, security, bitcoin, privacy, and Islamic

fintech. Research on Fin-Tech is dominated by quantitative methods, as opposed to qualitative and hybrid methods, although the use of methods such as Artificial Intelligence, machine learning and the Common Moment Method is increasing in statistical methods.

Author's Contribution

Shahrul Nizam Salahudin: Contribute to conceptualization and review

Yosy Arisandy: Contributing to data processing, writing original draft and editing.

Yosza Dasril: Contribute to the supervision and validation.

Declaration of Competing Interest

The author declares that there is no conflict of interest.

Ethical Approval

Ethical approval No patient-identifying parts in this paper were used or known to the authors. Therefore, no ethical approval was requested.

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