E-money Academic: Lesson from Literature Visualizing Scientometric Positioning (1968-2019)

A Purnomo*, M Firdaus, U Hasanah, A V D Sano and M A Prasnowo

1 Bina Nusantara University, Indonesia
2 Universitas Nahdlatul Ulama Sidoarjo, Indonesia
3 Universitas Trunojoyo Madura, Indonesia
4 Universitas Ma’arif Hasyim Latif, Indonesia

E-mail: agung.purnomo@binus.ac.id

Abstract. There is no overview of literature in the area of e-money research which shows the big picture using data from all countries. This paper aims to review the status and visual map position of research in the e-money literature indexed Scopus that used a scientometric positioning overview. The research was carried out using bibliometric techniques. Data analysis as well as visualization utilizing VOSViewer program and the Scopus function for analyze search results. In this review, the details collected applied to 3,011 documents issued from 1968 through 2019. The study reveals that Miller, A. and Chinese Academy of Sciences were the most active individual scientists and affiliated institutions in e-money literature. In e-money, computer science and Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics were the most areas of study and dissemination sources. There were nine worldwide group maps with collaborative researchers. In order to identify the body of knowledge created from fifty-one years of literature, this study constructed a convergence axis grouping comprising of e-money: Mobile telecommunication system, Electronic cash system, Finance, Profitability, Investments, Intelligent system, abbreviated as MEFPII themes.

1. Introduction
As a fintech innovation that makes transactions easier for customers, e-money is here. The drastic inoculation of digital technology has an impact on all areas of contemporary life, particularly financial activity, leading to the need to develop new simulation methods and to analyze a large number of links and interactions between various financial agents [1]. Payments via the internet have grown in popularity in recent years. With the support of a website or client application, they are executed [2]. Several fintech technologies have been launched that have changed the way of trading and banking, such as digital wallets, payment applications, mobile banking, mobile trading, robo-advisor platforms, and peer-lending sites [3]. As a strategic information system, electronic payment systems, especially in developing countries, are considered one of the key components of economic growth and are very helpful in strengthening the capacity and delivery of financial services [4]. In addition, by providing financial services to the masses without having to have a bank account, digital payments that can be enabled specifically on smartphones can transform the lives of millions of people in developing countries [5].

Electronic money or e-money is a result of technological evolution that provides tools to escape transfers of physical money, known as digital money, mobile money, mobile payments, electronic
cash [6]. E-money is characterized as a stored value or prepaid commodity in which someone owns a sum of money in a fund record or value in electronic media [7]. Other definitions of electronic money are: 1) fulfilling property: circulation, no bank accounts, no compensation, universal use; 2) storing electronic devices, issuing funds obtained and received as a means of payment; 3) identifying user demands that are stored and received as payment on the system [8]. E-money is growing with the rise of digital entrepreneurship and technopreneurship.

E-money has benefits, from ease of use to ease of use in purchasing and selling transactions with e-money, including ease of use [9]. The benefits of using e-money include faster and more efficient, safer payment transactions that allow banking services to be better customized [10]. Other benefits of electronic money include: payments made via any cell phone, customers do not need a bank account, do not need the internet, communicate through SMS, and physical money can be exchanged at any time. It is possible to make online orders, service payments, national transfers, collection control, consumer-to-consumer purchases in supermarkets, public utilities [11]. On the other hand, e-money shows little value in a broad economy, namely the key advantages of the Consumer Payment Option Diary are 1) the ability to calculate expenses with payment instruments combined into solid transactions, 2) relatively low expenditures, and 3) relatively low cost-effective expenditures [12].

The use of e-money was initially for practicality, because if you want to buy anything, you don't need to bring cash. As required, e-money cardholders should choose an e-money card. Since the industry has many e-money cards and provides numerous payment facilities. In addition, not all retailers can allow e-money payment transactions or it can be said that no e-money card can fulfill all requirements [13]. There are many benefits of using e-money in the IoT-connected era, however, in general, previous research related to e-money was limited to one country [14], [15]. There is still a need for research to explain this. Unfortunately, despite presenting a broad image map visualized year over year with details from several published studies at the global scale, there has not been much literature on e-money. The strong positive relationship regarding affiliation, scholars, and the impact of scholarly studies has also not been explicitly discussed by any literature. This paper aims to review the status and visual map position of research in the internationally e-money literature indexed Scopus that used a scientometric perspective.

2. Research Methods

This review mapped the status of study conducted in the last 51 years at global level on the basis of e-money. In August 2020, this study collected data from the Scopus utilizing document search queries [16]. The research was carried out using bibliometric techniques. Data analysis as well as visualization utilizing VOSViewer program and the Scopus function for analyze search results [17]–[19]. The VOSViewer tool is used to build and visualize bibliometric networks, including the number of studies, countries, academic affiliations, keywords, scholars, fields and collaborations between writers [20].

This study identifies e-money keywords to recognize and look for Scopus database publications with 3,011 globally published documents from 1968 through 2019. The research confined collection of data to 2019 and excluding 2020. In order to reflect the state of the study over the entire year, the annual academic data collected from January to December. (TITLE-ABS-KEY (e-money) AND PUBYEAR <2020) is the query input command which is implemented while mining academic publication data on online database of Scopus.

The research applies a co-authorship analysis with authors' analysis units and full calculation systematic techniques utilizing VOSViewer to gain the collaboration research network of the international researcher. The research conducted an in-depth co-occurrence analysis with keyword relation analysis as well as a full systematic technique of calculation utilizing VOSViewer to generate a keyword map network.
3. Result and Discussion
E-money literature appear to be likely to increase and grow per year. The tallest point for international publication was 720 documents in 2019. Since 1968, publishing on e-money has already started.

3.1. E-Money Literature Most Common Organizational Affiliations

![Figure 1. Organizational Affiliation Number of Annual Literature of E-Money](image)

The leading research organizations in e-money literature was Chinese Academy of Sciences with 41 documents. Then followed by CNRS Centre National de la Recherche Scientifique, UCL, Shanghai Jiao Tong University, ETH Zürich, University of Luxembourg, Beihang University, Beijing University of Posts and Telecommunications, KU Leuven, Xidian University and Cornell University.

3.2. E-Money Literature Most Individual Researcher

![Figure 2. Most individual E-Money Literature Researcher](image)

The researcher in the area of e-money to the most writings was Miller, A. with 16 documents with it. Pursued by Wu, Q. with 13 documents, Liu, J.K. with 12 documents, Markantonakis, K. with 12...
documents, McCorry, P. with 11 documents, Akram, R.N. with ten documents, Bartoletti, M. with ten documents, Meiklejohn, S. with ten documents, Pointcheval, D. with ten documents, Biryukov, A. with nine documents and Bonneau, J. with nine documents.

3.3. E-Money Literature Most Common Nation

![Figure 3. Nation Number of Annual Literature of E-Money](image)

In e-money literature, the United States 582 academic documents was the leading research nation. Then, with 409 articles, the China followed. Then United Kingdom, India, Germany, Japan, France, South Korea, Indonesia, Australia, Italy, Canada and Taiwan.

3.4. The Largest Frequency of Literature of E-Money by Subject Area

![Figure 4. The Largest Frequency of Literature of E-Money by Subject Area](image)

With 2424 documents (41.3 percent), computer science was the most frequent topic in international e-money literature in the subject field. Then it was followed by engineering with 931 papers (15.9%), mathematics with 787 papers (13.4%), Decision-science with 406 papers (6.9%), business, management and accounting with 371 papers (6.3%), social science with 307 papers (5.2%),
economics, econometrics and finance with 137 papers (2.3%), physics and astronomy with 133 papers (2.3%).

3.5. Year Documents of E-Money Literature Sources
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics are the leader in the annual number of sources of e-money literature with 493 papers. Then, accompanied by 88 documents from the ACM International Conference Procedural Collection, Proceedings of the 38-document ACM Conference on Computer and Communications Stability, 37-document Physica A Statistical Mechanics and Its Applications, 33-document IEEE Access and 30-document Advances in Smart Systems and Computing.

3.6. Per Year Documents of the E-Money Literature Sources
The number of international publications on the e-money Summary has seen a growing trend each year. This can be seen in Figure 6, the highest publication peak in 2019, with 720 papers. Work on e-money has been running since 1968. In e-money reports, the number of documents per year is 720 documents in 2019, 681 documents in 2018, 458 documents in 2017, 279 papers in 2016 and 250 papers in 2015.

3.7. The Document Cited of E-Money Literature
The study of Schierz, P.G., Schilke, O., Wirtz, B.W. was the most widely cited literature, in 2010 entitled “Understanding Consumer Acceptance of Mobile Payment Services: An Empirical Analysis” in “Journal of Electronic Commerce Research and Application” with cited by 447 documents. Then, followed by Tschorsch, F., Scheuermann, B. in 2016 entitled “Bitcoin and beyond: A technical survey on decentralised digital currencies” in “IEEE Communications Surveys and Tutorials” with cited by 443 documents and Luu, L., Chu, D.-H., Olickel, H., Saxena, P., Hobor, A. in 2016 entitled “Making smart contracts smarter open access” in “Proceedings of the ACM Conference on Computer and Communications Security” with cited by 413.

3.8. Literature Theme Map

![Figure 7. Network of Keyword](VOSviewer)

With analysis and visualization of the VOSViewer program, construction was developed on the e-money keyword framework for the e-money of literature theme map. Three repetitions were the criterion for the minimum amount of keyword-related documents. Therefore, 13,229 keywords among 197 keywords reached the thresholds.

From Figure 7, there were six literature theme groups dependent on study keywords regarding the international academic literature of e-money, simplified as well as abbreviated as MEFPII themes.
3.8.1. Mobile telecommunication system cluster (blue)
We can find mobile telecommunication themes in this cluster. The mobile security, mutual authentication, near field communication, and radio frequency identification keywords were connected to this cluster.

3.8.2. Electronic cash system cluster (yellow)
The keywords of network security, data privacy, random oracle model, blind signatures, authentication and cryptography dominated this cluster. Many of these keywords are linked to themes in electronic cash system.

3.8.3. Finance clusters (red)
We can find finance themes in this cluster. The mobile payment, payment method, information system, technology acceptance model, human and sales keywords were connected to this cluster.

3.8.4. Profitability cluster (green)
The keywords of profitability, block-chain, bitcoin, internet of things, game theory, proof-of-work, chains and miners dominated this cluster. Many of these keywords are linked to themes in profitability.

3.8.5. Investments cluster (purple)
We can find investments themes in this cluster. The costs, neural network, machine learning, forecasting, data mining and cryptocurrencies keywords were connected to this cluster.

3.8.6. Intelligent system cluster (orange)
The keywords of intelligent system and transportation dominated this cluster. Many of these keywords are linked to themes in intelligent system.

3.9. Network of Authorship
With the VOSViewer program, construction was developed on the e-money researcher framework for the authorship network map. One document was one of the requirements for the minimum collection of publications per author. Thus, out of 14,125 researchers, 102 researchers who reached the thresholds were recognized.

As shown in the figure 8, there were nine group partnership networks between international researchers in e-money publications. The green cluster of e-money publication which contains Saxena, P., Wattenhofer, R., Juels, A., Pass, R., Bentov, I., Miller, A., Miers, I., Karame, G.O. They dominant from United States. The purple cluster which contains Böhme, R., Meiklejohn, S., Mcorry, P., Liu, I., Chen, Z., Sun, H., Liu, X., Liu Y., Ruffing, T. They dominant from United States. The yellow cluster which contains Yuan, Y., Zhang, M., Wang, C. They both from China. The pink cluster which contains Yang, Y., Yang, C., Li, X., Li, H. They both from China. The brown cluster which contains Kiayias, A., He, Y., Li, B., Li, Y. They both from England. The dark blue cluster which contains Yang, D., Zhang, Y., Liu, Z., Tang, S., Zhang, J., He, D., Huang, Y. They dominant from China. The light blue cluster which contains Au, M. H., Liu, J.K., Steinfeld, R. They dominant from United States. The orange cluster which contains Sun, Y., Wang, M., Liu, J., Chen, X., Wu, Q. They dominant from China. Then the red cluster which contains Wang, Y., Li, Z., Huang, X. They dominant from China.

4. Conclusion

The results of this research revealed that there is an annual trend towards a spike in the amount of international literature on e-money, there were maps and visual patterns. With 582 papers, the United States was the country with the greatest contribution to literature in e-money studies. In the publication of the e-money literature, Chinese Academy of Sciences was the most active research institution with 41 papers. In the e-money literature, the individual academic researcher with the most prolific publications was Miller, A. 16 papers with it. With 2424 documents (41.3 percent), the most
Intensively studied areas published in the e-money literature were computer science. The “Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics” with 493 documents was the majority of annual documents by the source in the e-money literature. With 720 papers, the highest publication of worldwide scholarly literature in e-money studies was in 2019. The works of Schierz, P.G., Schilke, O., Wirtz, B.W. were mostly literature with the most citations. In 2010, the “Journal of Electronic Commerce Research and Application” cited 447 documents entitled "Understanding Consumer Acceptance of Mobile Payment Services: An Empirical Analysis". There were nine researcher partnership groups linked to the literature of e-money.

In terms of contributing knowledge implications, this study recommends a classification of the convergence axis comprising of literature in e-money to classify the body of knowledge created from fifty-one years of academic literature: Mobile telecommunication system, Electronic cash system, Finance, Profitability, Investments, Intelligent system, abbreviated as MEFPII themes. The identification of key themes in the e-money area, as practical implication, contributes to an awareness of the creation of practical studies to clarify general contexts and topics, as well as research gaps. All this will lead to fresh research addressing a lack of study and specialized expertise in the disciplines. The most studied themes often reflect the ability to contribute of e-money to finance, e-commerce, digital business, investments and electronic cash system.

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References
[1] O. E. Pyrkina and S. A. Zadadaev, “Application of Crash-Tests for Graph Analytics of Electronic Payment Complex System for Investigation of System Economic Security,” in 2019 Twelfth International Conference “Management of large-scale system development” (MLSD), 2019, pp. 1–4, doi: 10.1109/MLSD.2019.8911069.
[2] N. Polyakov, F. Tishkin, L. Cherckesova, and O. Safaryan, “Security of User Authentication in Payment Systems in the Agricultural Value Chain,” IOP Conf. Ser. Earth Environ. Sci., vol. 403, p. 012161, Dec. 2019, doi: 10.1088/1755-1315/403/1/012161.
[3] C. Khiewngamdee and H. Yan, “The Role of Fintech E-payment on APEC Economic Development,” J. Phys. Conf. Ser., vol. 1324, p. 012099, Oct. 2019, doi: 10.1088/1742-6596/1324/1/012099.
[4] Z. Bezhovski, “The Future of the Mobile Payment as Electronic Payment System,” Eur. J. Bus. Manag., vol. 8, no. 8, pp. 127–132, 2016.
[5] P. P. Patil, Y. K. Dwivedi, and N. P. Rana, “Digital Payments Adoption: An Analysis of Literature,” 2017, pp. 61–70.
[6] S. Hapugoda and C. Hewagamage, “Analysis of the Necessity of Developing Regulatory Guidelines for E-Money Operations in Sri Lanka,” in 2015 Fifteenth International Conference on Advances in ICT for Emerging Regions (ICTer), 2015, pp. 272–272, doi: 10.1109/ICTER.2015.7377705.
[7] H. Mandari and D. Koloseni, “Why Mobile Money Users Keep Increasing? Investigating the Continuance Usage of Mobile Money Services in Tanzania,” J. Int. Technol. Inf. Manag., vol. 26, no. 2, pp. 77–86, 2017.
[8] V. V. Pshenichnikov and A. V. Babkin, “Digital Money as A Product of the Development of Information and Telecommunication Technologies,” in 2017 International Conference “Quality Management, Transport and Information Security, Information Technologies” (IT&QM&IS), 2017, pp. 267–273, doi: 10.1109/ITMQIS.2017.8085808.
[9] R. Agrawal, “Mobile Money Empowering People Living at Bottom of Pyramid and Boosting
Socio-Economic Development in a Big Way,” Econ. Anal., vol. 49, no. 1–2, pp. 15–23, 2016.

[10] A. Seetharama and J. Rudolph Ra, “An Empirical Study on the Impact of Earnings per Share on Stock Prices of a Listed Bank in Malaysia,” Int. J. Appl. Econ. Financ., vol. 5, no. 2, pp. 114–126, Feb. 2011, doi: 10.3923/ijaf.2011.114.126.

[11] S. M. T. Toapanta, A. A. S. Balladares, D. F. H. Subia, and L. E. M. Gallegos, “Prototype of a Security Model to Mitigate Risks in the Management of Electronic Money in Ecuador,” in 2019 Third World Conference on Smart Trends in Systems Security and Sustainability (WorldS4), 2019, pp. 87–93, doi: 10.1109/WorldS4.2019.8903959.

[12] S. Schuh, “Measuring Consumer Expenditures with Payment Diaries,” Econ. Inq., vol. 56, no. 1, pp. 13–49, 2017.

[13] D. Haryadi, Harisno, V. H. Kusumawardhana, and H. L. H. S. Warnars, “The Implementation of E-money in Mobile Phone: A Case Study at PT Bank KEB Hana,” in 2018 Indonesian Association for Pattern Recognition International Conference (INAPR), 2018, pp. 202–206, doi: 10.1109/INAPR.2018.8627055.

[14] S. A. E. A. Elmagid and A. Z. Karrar, “E-payment Adoption by Petroleum Companies in Sudan,” in 2019 International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE), 2019, pp. 1–8, doi: 10.1109/ICCCEEE46830.2019.9071021.

[15] D. W. C. Soon, T. C. Wei, and L. W. Lee, “Factors Influencing Consumers’ Perception on Mobile Payment among Generation Z in Malaysia,” in Proceedings of the 2nd International Conference on Big Data Technologies - ICBDT2019, 2019, pp. 316–319, doi: 10.1145/3358528.3358536.

[16] A. Purnomo and M. Firdaus, “E-Money Research Dataset (1968-2019),” Mendeley Data, 2020. https://data.mendeley.com/datasets/4pc7nmmjdy/1.

[17] N. J. van Eck and L. Waltman, “Software survey: VOSviewer, A Computer Program for Bibliometric Mapping,” Scientometrics, vol. 84, no. 2, pp. 523–538, Aug. 2010, doi: 10.1007/s11192-009-0146-3.

[18] A. Purnomo, T. Susanti, A. K. Sari, M. Firdaus, and R. Dewi, “A Study of Digital Entrepreneurship through Bibliometric Visualizing from 1993 to 2019,” in 2020 International Conference on Information Management and Technology (ICIMTech), 2020, pp. 911–915, doi: 10.1109/ICIMTech50083.2020.9211270.

[19] A. Purnomo, A. Septianto, D. U. Sutiksono, M. I. Hikmawan, and R. D. Kumalasari, “Technopreneur Publication: A Bibliometric Analysis (2000–2019),” in 2020 International Conference on Information Management and Technology (ICIMTech), 2020, pp. 521–526, doi: 10.1109/ICIMTech50083.2020.9211111.

[20] B. Ranjbar-Sahraei and R. R. Negenborn, Research Positioning & Trend Identification. Walanda: TU Delft, 2017.