Article

Analysis and Visualization of Scientific Research on Islamic Banking and Artificial Intelligence

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***Abstract*:** Recent years have seen dramatic growth in the number of scholarly scientific works dedicated to the topic of Artificial Intelligence (AI), banking, and finance. With the development of scientometric tools, it is now possible to map, visualize, analyze, and assess scientific activities in many fields of engineering and social sciences including Islamic banking and finance. Based on data retrieved from the Scopus database and using a qualitative method, this study investigates, evaluates, and identifies significant development, trends, and players in the application of AI in Islamic banking and finance using the Visualization Of Similarities Method (VOS) between objects in VOSviewer. From 2006 to 2022, 387 documents were retrieved from the Scopus database; Results revealed that the top five most active countries in terms of publications are Malaysia (117 documents), Indonesia (89 documents), the United Kingdom (36 documents), the USA (24 documents), and Saudi Arabia and Bahrain (24 documents each). The International Islamic University Malaysia and Universitas Indonesia came out on top of active institutions while the top funding source came from the Ministry of Higher Education, Malaysia. The comprehensive findings and analysis reported in this study serve as a roadmap for future academics to create theory and practice for applying AI in Islamic banking and finance.

Keywords: Scientometric; Bibliometric; Islamic Banking; Islamic Finance; Artificial Intelligence

1. Introduction

The term "artificial intelligence" is used to refer to a wide variety of different technologies. Some of these technologies include but are not limited to machine learning, deep learning, neural network, automation, expert systems, intelligent systems, smart systems, Natural Language Processing, robotics, and so on. Regardless of the many definitions given by researchers to artificial intelligence (AI) [1], [2], the consensus is that it refers to the use of computers and other machines and devices considered systems that are capable of thinking and acting like humans as well as thinking and acting rationally. The use of AI in the manufacturing and industrial sectors has been on the rise for many years. Today AI is having an effect in almost every facet of contemporary society, including the entertainment industry, the business world, and healthcare [3]–[5]. However, the introduction of AI in the financial sector is still in its infancy compared to other sectors, with most solutions focusing on banking transactions, financial and social services delivery, and automating business processes [6]–[9]. The first Islamic and Commercial Bank was established in 1979 in Egypt. In the same year, Bahrain established the first Bahrain Islamic Bank (BisB). Bank Islam Malaysia was founded in 1983. Since the late 1990s, Islamic Banking institutions have grown at an annual pace of ten to fifteen percent, and many Islamic financial institutions have been established in Asia, Africa, Middle east, as well as in the West such as Citi Islamic Investment Bank in the United Kingdom, Lariba American Finance House in the United States, Arab Bank in Switzerland, and Islamic Finance & Investments in Australia [10]. Several research has been conducted on the challenges and benefits of

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Islamic banking [10]–[12]. According to our search in the Scopus database, the first study on Islamic banking and mobile credit card was conducted by Hanudin [13] in 2007. The objective of this study was to investigate factors influencing Malaysian bank customers' intentions to use mobile credit cards as a better method for completing payment transactions. Hall et al. [14] were the first authors who used machine learning techniques to study Indonesian Islamic banking. The objective was to predict Indonesian Islamic banks' exposures to macroeconomic variables such as inflation, exchange rates, stock prices, GDP, etc. Other institutions providing financial services have integrated AI into their risk management or revenue production processes, and several previous research focused on either Islamic banking or AI [15]–[17]. For example, Arjun et al. [6] addressed the current study of banking by providing a comprehensive review covering the period from 1970 to 2020 and focusing on intelligent decision support models in the banking industry. Çürük and Kaynar [18] investigated research on Islamic finance, Islamic banking, and Islamic economy, during the post-crisis period (2008-2020) using the Web of Science database; the author found that Malaysia was the most active country in terms of publications and citations. Biancone et al. [17] investigated “Islamic finance” or “Islamic bank” in “all fields” of the Scopus database and retrieved 7,662 scientific articles published between 1980 and 2020. Hassanein and Mostafa [16] used the Web of Science database and retrieved 464 scientific articles on Islamic banking and finance published between 1990 and 2019, indicating weak collaboration between countries. Other studies explored AI and finance or banking like Shamima et al. [19] who used the Scopus database and retrieved 348 documents published on Artificial intelligence and finance between 2011 and 2021. The authors indicated that AI was applied in forecasting bankruptcies, stock prices, and agricultural prices. Many similar studies can be found in the literature, however, to the best of the authors’ knowledge, no study was conducted on analyzing scientific research on Islamic banking and AI. This study attempts to present a thorough analysis of Scopus-indexed scientific research on Islamic Banking and Artificial Intelligence focusing on research output, research directions, most active institutions, citations, keywords, and collaborations within the Islamic Countries and the rest of the world. The rest of the paper is organized as follows: section 2 present the state-of-the-art of Islamic Banking. Section 3 describes the research methodology for generating various bibliometric visualizations and trends. Section 4 presents the results and discussion. Finally, section 5 presents the conclusion.

2. Islamic Baking: State-of-the-Art

An Islamic financial system is a fully fledged financial system that first and foremost complies with a set of rules and laws commonly referred to as Shariah. The latter is derived from the rules dictated by the Quran and its practices, the Sunnah (explanations given by the Prophet Muhammed), and finally from the rules provided by scholars in Islamic jurisprudence within the framework of the Quran and Sunnah. The overall principle of Shariah is the abolition of interest and all other prohibited activities that link with transactions such as gambling, speculations, excessive uncertainty (gharar), and illegitimate transactions related to pornography, tobacco, short-selling, alcohol, and any other activities considered to be detrimental to society ([30]; [31]; [32]; [33]). Instead of these, the Islamic financial system focuses on real economic activities through rewards and risk sharing of businesses outcomes between and among all the involved parties.

The Islamic financial system is composed by the Islamic banking system, the Islamic money market, the Islamic insurance, and the Islamic capital market. Banking is the most developed part of the Islamic financial system. Actually, Islamic banks are becoming more resourceful and are going global. This recent growth and complexity of the system’s practices have stimulated researchers to investigate its empirical differences from its conventional counterpart. As per ([28]; [29]), the main difference between Islamic banks and conventional banks is that the

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latter are in the business based on interest while Islamic banks follow the principle of interest-free financing. Based on Shariah guidelines, Islamic banking operates through two main channels. The first channel is the "specialized" Islamic bank, which is the equivalent of conventional commercial and investment bank but structured wholly on Islamic principles and dealing only with Islamic instruments. The second channel is the Islamic window, which is a special facility offered by a conventional bank to provide customized services to clients who wish to engage in Islamic banking. It is the case for example for Western banks and banks headquartered in Islamic countries which provide Islamic windows.

Some countries, such as Iran or Pakistan, require their banking system to be fully compatible with Islamic law [27]. While other countries such as Egypt, Indonesia, Malaysia, and countries from the Golf Cooperation Council, are embarking in a dual banking system where the specialized Islamic banking exists alongside the conventional baking. The relationship between conventional and Islamic banking is ambiguous; Islamic banks experience an increased integration with international markets, however, although they have been well positioned to attract deposits from Muslims, these institutions have generally lacked the technical ability to invest efficiently. This gap is bridged by conventional banks which are aware of the high potential of Islamic markets, thus seeking to attract the investments directly through Shariah compliance products. It is the case for example of Citibank which opened its first Islamic bank subsidiary in Bahrain in 1996 [26]. Furthermore, the International Finance Corporation (IFC) has successfully executed several transactions in the Middle East and Pakistan that conform to Islamic principles. This co-existence of both Islamic and conventional banking systems may represent a threat to Islamic banking, as it has to compete to survive, to innovate permanently without exceeding the framework of its paradigm. The Islamic banking paradigm was first developed based on rewards and risk sharing with the aim of promoting social well-being. Nonetheless, the business complexity and the struggle for survival tend to drive a divergence from the original concepts that established the system and any paradigm shift within the system may draw the attention of scholars and policymakers and lead to inconclusive debates. For example, the introduction of derivative products is being cautiously studied, it is suspected that they incorporate interest and may also support speculative activities [26] . To conclude, one of the most important keys to competitiveness is efficiency. Indeed, if banks are efficient, they would expect an improved profitability, better prices and quality services for consumers [26]. The efficiency of Islamic banks is a key pillar to its survival. The production process has been found to be more cost and profit efficient than conventional counterparts because of lower funding costs and loan loss levels [25]. An improvement in cost efficiency means achieving higher profit and increasing the chance of survival in competitive markets [24]. The question that is naturally drawn at this stage is : How can AI contribute to a higher cost-efficiency among Islamic banks?

3. Methodology

A bibliometric analysis is a statistical tool used to discover emergent patterns in scientific research papers published and saved in databases such as the Scopus and Web of Science databases [20], [21]. In addition to this, bibliometric is also used to recognize patterns of collaborative work and active research institutions in a specific field, as well as to investigate the intellectual structure of a certain area as it is presented in the relevant literature. Figure 1 presents the primary steps of the bibliometric analysis used in this research study. The data presented here were derived and extracted from the Scopus database, which is a large and comprehensive database that covers a wide variety of subject areas and is comprised of literature that has been peer-reviewed and is rich in scientific and academic material [22], [23]. Based on data retrieved from the Scopus database and using a qualitative method, the study investigates, evaluates, and identifies significant development, trends, and players in the application of AI in Islamic banking and finance using the Visualization Of Similarities Method (VOS) between objects incorporated into the VOSviewer software 1.6.18 [24],

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[25]. The extracted data are exported as a CSV file from the Scopus database, then uploaded into VOSviewer for mapping and visualization.

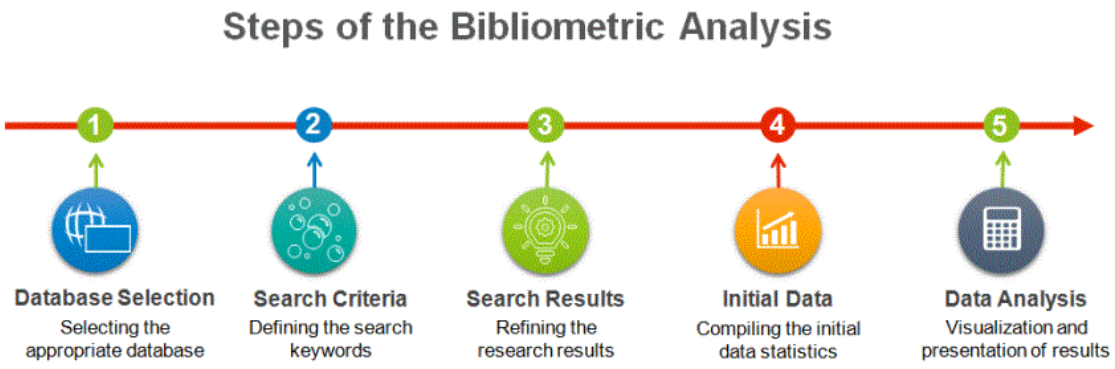

Figure 1. Main stages of the bibliometric analysis.

4. Results and Discussion

In this study, Islamic Banking and AI were first identified from literature review, then a retrieval search using keywords and Boolean for the closest matching of published articles in the Scopus database was performed based on English language fro the year 2007-2022 and using the query: (TITLE-ABS-KEY (("Islamic Bank*" OR "Halal Bank" OR "Shariah Bank*" OR "religious bank*" OR "Islamic Financ*" OR "Islamic Bonds" OR "Islamic Accounting" OR "Murab*" OR "Musharak*" OR "Mudarib" OR "Mudarab*" OR "Mutajara" OR "Islamic Investment" OR "Islamic Leasing" OR "Bai Al Ajel" OR "Bai al Arboon" OR "Islamic guarantee*" OR "Bay' Muajjal" OR "Istisna" OR "Ijar*" OR "Iqtina*" OR "Zakat" OR "Waqaf" OR "Riba" OR "Qard*" OR "Qirad*" OR "Qardh Al Hasan" OR "Sukuk" OR "Suk" OR "Takaful" OR "Islamic Insurance" OR "Islamic Stock" OR "Islamic Investment" OR "Sharia stock" OR "Islamic Accounting")) AND (TITLE-ABS-KEY ("AI" OR "artificial intel*" OR "machine learning" OR "Deep Learning" OR "neural network*" OR "SVM" OR "ANN" OR "automation" OR "data mining" OR "Expert System*" OR "Intelligent" OR "Smart" OR "Digital*" OR "Fintech" OR "natural language processing" OR "Fuzzy Logic" OR "sentiment classification" OR "information retrieval" OR "text classification" OR "web mining" OR "NLP" OR "feature selection" OR "Opinion extraction" OR "ontology" OR "unsupervised learning"))) AND PUBYEAR > 2006 AND PUBYEAR < 2023 AND (LIMIT-TO (LANGUAGE , "English"). As indicated from the query, the first part is related to Islamic banking while the second part of the query is related to Artificial Intelligence-related topics. The years were chosen because, as previously noted, the first publication on Islamic banking and mobile credit cards was in 2007. Figure 2 displays the chronological distribution of published documents and citations related to Islamic banking and AI. From 2007 to 2022, 419 documents were retrieved from the Scopus database, but 32 documents were excluded because they were not directly related to the topic of this study or were missing the authors' names. As indicated in figure 2, the number of publications has increased from 2 documents and 0 citations in 2007 to 78 documents and 734 citations in 2022. The top five most popular subject areas of these published documents, displayed in figure 3, are Business Management and Accounting (19%); Economics, Econometrics, and Finance (17%); Computer Science (14%); Social Sciences (13%); and Engineering (10%). As

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expected, most of the published documents were on the topic of Business, Finance, Economics, and Computer Science. The number of publications retrieved from Journals and conferences was 252 and 79 respectively while the rest was published as book chapters, and review. The retrieved data indicated that the documents were mainly published by the "International Journal of Islamic and Middle Eastern Finance and Management", "Journal of Islamic Marketing", "Lecture Notes in Networks and Systems", "Journal of Islamic Accounting and Business Research", and "ACM International Conference Proceeding Series". Figure 4 displays the top five most active countries, Malaysia with 117 documents, Indonesia with 89 documents, the United Kingdom with 36 documents, the USA with 24 documents, and Saudi Arabia and Bahrain with 24 documents each. The International Islamic University Malaysia and Universitas Indonesia, figure 5, came out on top of active institutions while the top funding source came from the Ministry of Higher Education, Malaysia.

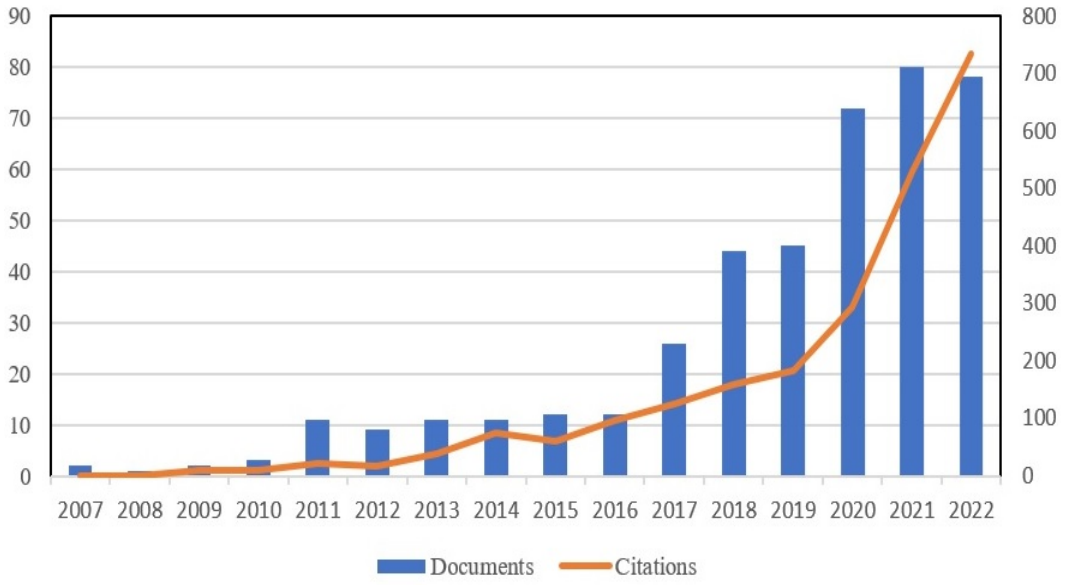

Figure 2. Chronological distribution of published documents by year.

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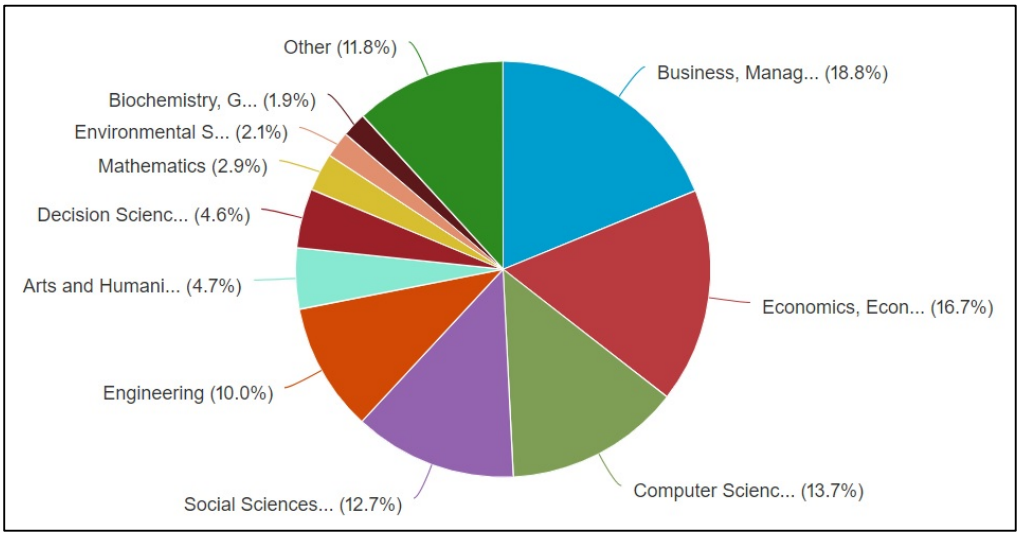

Figure 3. Distribution of published documents by subject area.

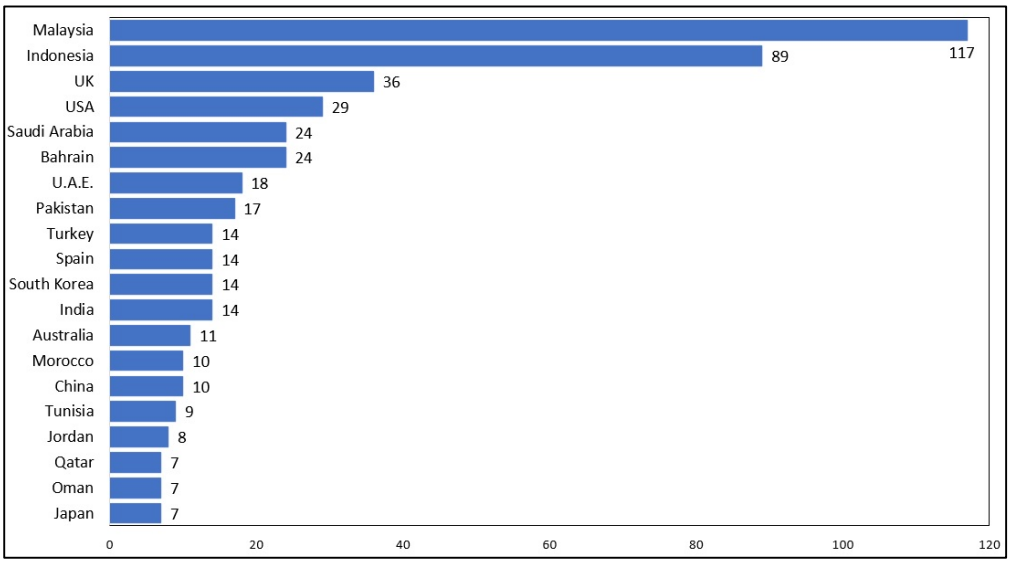

Figure. 4. Distribution of published documents per year by country.

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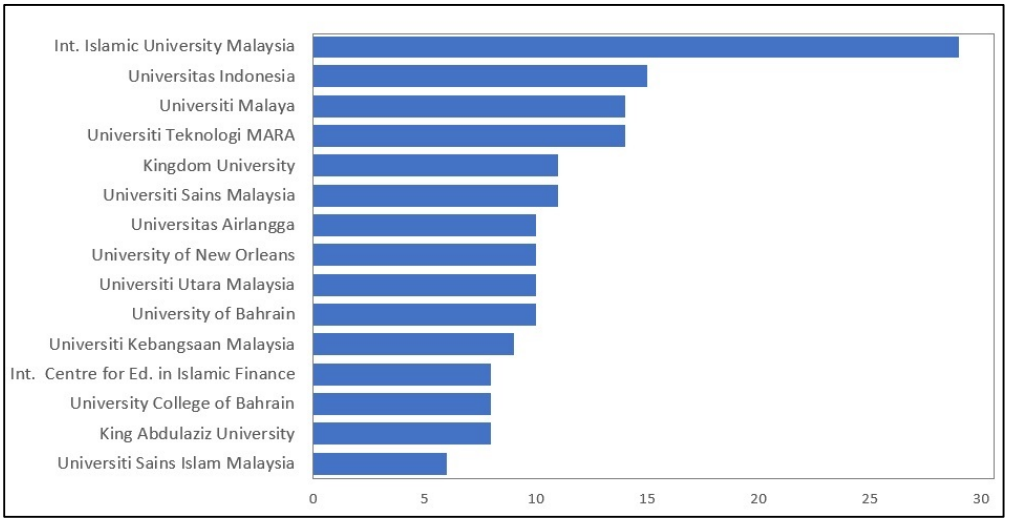

Figure. 5. Distribution of published documents by affiliation.

Analyzing the keywords of publications collected from a database is one of the most significant phases in bibliometric analysis. Figure 6 shows a keyword cluster map based on author keywords with a minimum of 3 occurrences. The six major clusters were built using different colors: the red cluster covers AI and related machine learning techniques, the green cluster covers financial sectors and data mining techniques, the navy-blue cluster covers digitalization and finance, the mustard cluster covers banking systems and economics, the purple cluster covers blockchain and digital technology, and the cyan cluster covers banking services. Note that each circle represents a network node while the size of each node determines its importance. The distance between two nodes reflects the strength of the relation between two nodes. A shorter distance generally reveals a stronger relationship. The more frequently they appear together, the thicker the line. The examination of figure 6 reveals several important and insightful observations. For example, the nodes Islamic finance, fintech, and Islamic banking dominate the co-occurrence network display. Artificial Intelligence, machine learning, and data mining come second in the importance of co-occurrence network display. Based on the high level of relationships of these nodes, this suggests that extensive work is being conducted on AI in Islamic banking.

The overlay visualization and density visualizations are displayed in figures 7 and 8 respectively. The result in figure 6 shows the trend and development of the publications over time. This visualization suggests that since 2020 there is a tendency to work on fintech, Islamic fintech, and machine learning, as well as Covid-19. Objects in the density visualization, figure 8, are represented in the same way as in the network and overlay visualizations. The color of each object represents the density of the point. By default, the colors range from blue to green to yellow. For higher weights of the neighboring items, the color is yellow as in the case of AI and Islamic banking items displayed in figure 8. These findings provided insight into the future of AI and Islamic banking and call for collaboration between countries to implement sustainable AI in Islamic banking. To look at this trend, figure 9 displays the nodes of network visualization of countries as extracted from the Scopus database. It is clear from this figure that the two countries, Malaysia and Indonesia, show a strong tie as indicated by the thickness of the line connecting the two countries. This result suggests that the rest of the countries, in particular Islamic countries, need to build strong collaborative work not only to learn from each other but also to move quickly on applying AI in Islamic banking.

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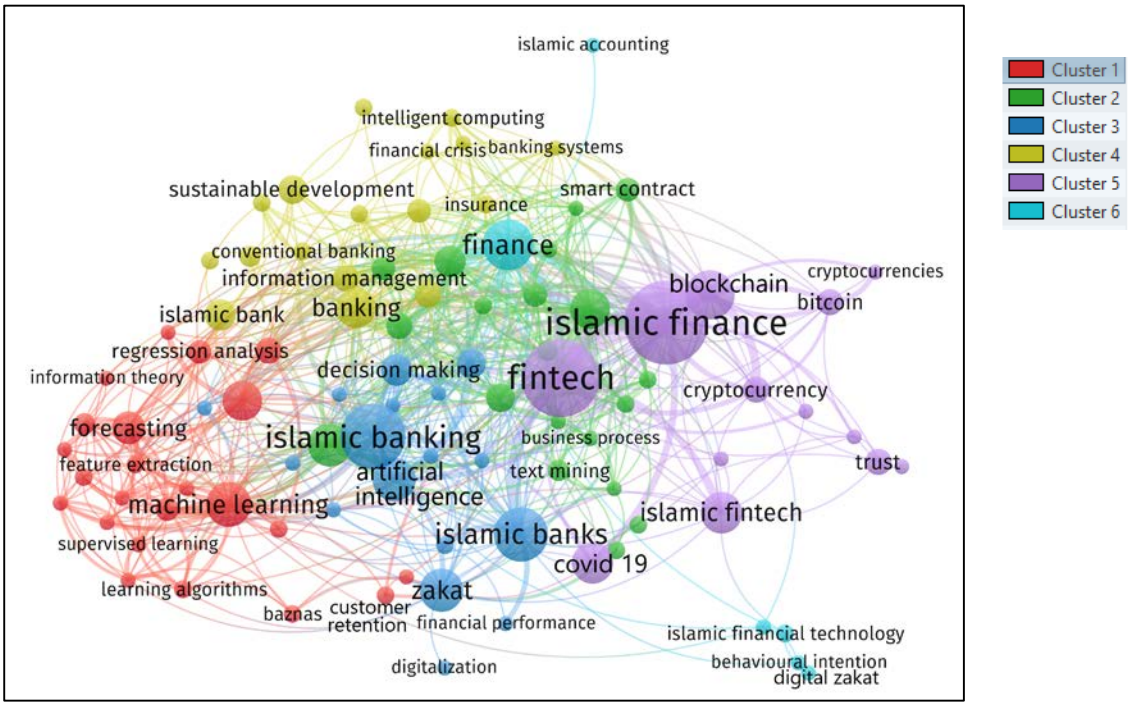

Figure 6. Co-occurrence network of keywords (2006-2022).

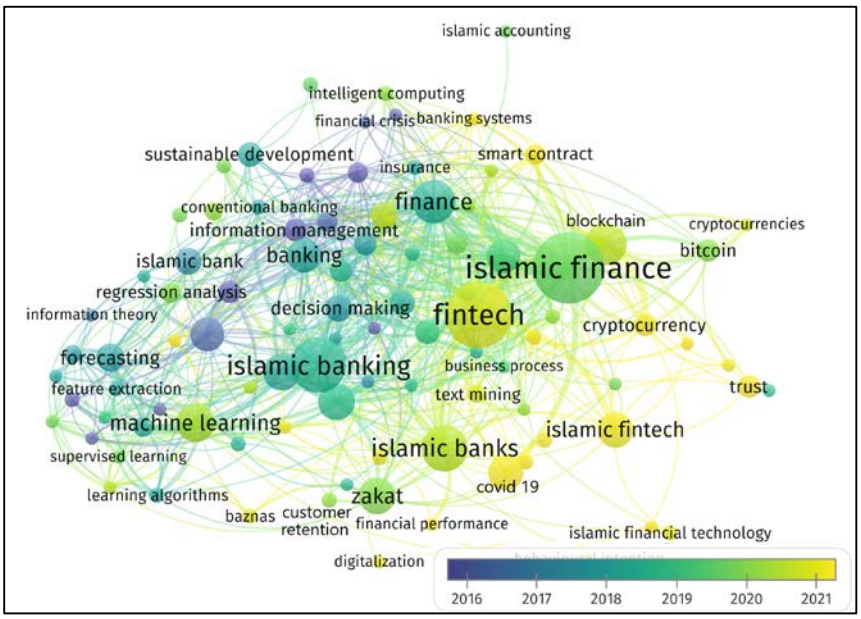

Figure 7. Overlay visualization of most frequent keywords (2006-2022).

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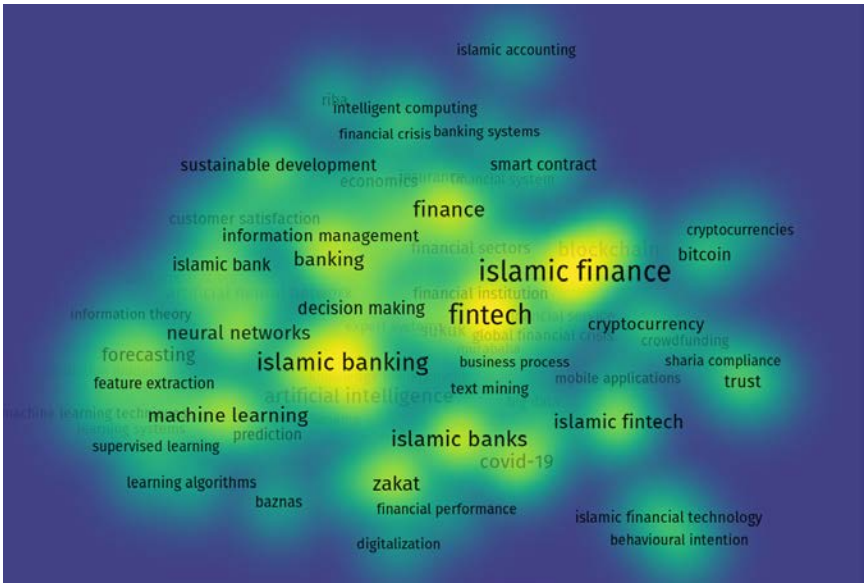

Figure 8. Density visualization map (2006-2022).

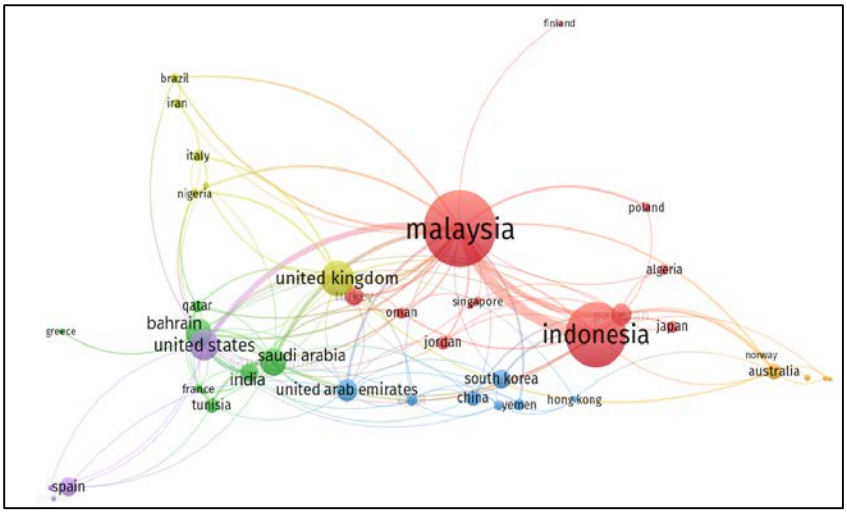

Figure 9 Co-authorship of the collaborative network between countries (2006-2022).

5. Conclusion

Bibliometric analysis of research in AI and Islamic Banking offers unmatched opportunities to make significant contributions to theory and practice that spans several fields and disciplines such as banking, finance, blockchain, and cryptocurrency. However, according to this study, the introduction of AI in the Islamic banking sector is still in its infancy compared to other sectors, with most solutions focusing on banking transactions, financial, and social services delivery, and automating business processes. Results revealed that the top five most active countries in terms of publications are Malaysia, Indonesia, the United Kingdom, the USA, Saudi Arabia, and Bahrain. The International Islamic University Malaysia and Universitas Indonesia came out on top of active institutions while the top funding source came from the Ministry of Higher Education, Malaysia. This finding implies that countries, particularly Islamic nations, must develop significant collaborative efforts to move swiftly on using AI in Islamic banking. The comprehensive findings and analysis reported in this study serve as a path for future research and collaboration between countries to apply AI in Islamic banking.

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