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The evolution of banking digitalisation research: a bibliometric and conceptual analysis

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Abstract
The digitalisation of the banking sector is a ubiquitous topic in the contemporary financial industry, catalysed by the unprecedented expansion of new technologies and artificial intelligence. To identify how the specialised literature addresses banking digitalisation, this study analyses how published studies relate to this issue and uses VOSviewer to map existing research. The analysis is based on studies published in the ScienceDirect database from 2022-2026, a period that also covers the COVID pandemic, which catalysed banking digitalisation and profoundly transformed the field. As expected, the analysis identified an exponential increase in published studies on banking digitalisation, highlighting the topic's timeliness and the related challenges, particularly the safe use of new technologies and the role of artificial intelligence in banking. The analysis is useful for banking regulators and financial institution management who need to understand the huge potential of new banking technologies, as well as the related risks that can affect the resilience and sustainable development of the banking sector.

Keywords: digitalisation, banking sector, fintech, artificial intelligence, machine learning, financial inclusion

Introduction

One of today's banking customers' most important expectations is to avoid spending a lot of time resolving issues through bank interactions and to manage their banking needs remotely, without physically travelling to bank branches. This behaviour crystallised especially during the COVID pandemic and forced financial institutions into a race for accelerated digitalisation. In such a competitive field as banking, fierce competition among financial institutions has also driven the evolution of digitisation processes, as they aim to attract and retain customers through digitised services. The unprecedented expansion of digital technologies and artificial intelligence has made the banking environment strongly impacted and affected by these technological changes, which have also changed the expectations of banking customers, in the

century of speed and increasingly familiar with the language that contains such digital terms or artificial intelligence or from the same area, such as blockchain.

It is not surprising that the scientific literature in the field has not remained indifferent to the real expansion of digital technologies in banks, and we are witnessing rapid growth in published studies in recent years. The vastness of the literature on banking digitalisation is obvious, making it difficult to identify existing patterns and trends, relevant terms, or sufficiently substantiated studies. This approach faces the sheer volume of studies, the difficulty of identifying them exhaustively, and the help offered by key term mapping software, such as VOSviewer, which is important in this context. Through scientific mapping of the literature on banking digitalisation, essential trends and their links to banking management, security, customer experience, operational risks, and other aspects that require legislative regulation can be highlighted.

The purpose of this study is to identify the corpus of literature in the field of banking digitalisation published in a relevant international database – ScienceDirect and to subsequently analyse it with the VOSviewer software to identify the relevant aspects of the dominant keyword network and the substance of this research. In this way, the study can contribute to increasing knowledge in this field, which is being profoundly impacted and rapidly transformed by new digital technologies. The research contributes to the literature by offering an integrated perspective on the digitalisation of the banking sector and by analysing recent work through conceptual mapping, highlighting the main clusters of research directions, the dominant concepts, and the links between them. Through this approach, the study provides a comprehensive picture of how recent knowledge in banking digitalisation has developed and diversified. For banking regulators, the study can be useful for other vital research, as it can open the way to new research questions, and for banking regulators and financial institutions it can contribute to an even clearer delineation of the main challenges and directions of action associated with banking digitalisation, in conditions of customer safety, resilience and the health of institutions in the field.

For the scientific mapping of the specialised literature, VOSviewer was used to identify the dominant clusters and concepts in the literature flow from the international database ScienceDirect, for studies published in English. The search strategy was built around the keyword "bank digitalisation", and in order to ensure the relevance of the results, only publications in the fields of Business, Management and Accounting, Economics, Econometrics and Finance were included. The analysed period covers 2022–2026, with data collected on March 18, 2026.

For each year, 1000 articles were selected, exported in RIS format, and processed using the VOSviewer software. The analysis included both descriptive bibliometric indicators (the evolution of the number of publications, typology of documents and distribution by journals), as well as techniques for analysing bibliometric networks. The scientific mapping software allows analysis of keyword co-occurrence in the identified studies, helping clearly delimit the studied trends and the dominance of certain topics. The software also allows the configuration of a network of keywords, from which it is possible to observe how the relevant terms interconnect.

The paper consists of the following sections: a literature review, the research method, the actual analysis and discussion, and the final section of conclusions.

2. Literature review

Even if banking digitalisation is predominantly associated with positive valences, regarding the support of banking management processes, the development of modern and

innovative banking products and the increase in operational efficiency, we should not omit the possible associated cyber risks and continuous investment costs necessary to keep technological equipment and software in optimal parameters for the functioning of financial institutions and in accordance with specific legislation. The expansion of digital technologies in banking has been mainly sustained by the high proliferation rates of phones and smart devices, extensive Internet connections and the emergence of innovative financial technologies.

Banking activities that were once considered traditional and focused on customer interaction, as well as back-office operations, are now shaped by digitalisation, which has profoundly changed how contemporary banking operates (Naimi-Sadigh et al., 2022). As Diener and Spaček (2021) emphasise, financial institutions increasingly recognise that banking digitalisation is a key factor in maintaining competitiveness and relevance in a highly volatile digital landscape.

In a broad context of the digital economy, financial institutions are in turn profoundly transformed by digitisation processes, associated with stimulating innovation, raising the efficiency of banking services and increasing institutional capacity to adapt faster to change. Banking digitalisation research is a highly topical and expanding field, focusing in particular on the challenges of integrating digital technologies into financial institutions, improving process efficiency, fostering banking innovation, and enhancing customer satisfaction (Xuan et al., 2025). Digital transformation is often described as a key force reshaping the banking environment, driven by technological advances and customers' preferences for digital banking (Kitsios et al., 2021; Rodrigues et al., 2022).

The institutional development of banks is influenced by the place and importance given to digitisation processes. Banks that understand and adopt digital technologies better adapt to market and customer requirements and manage organisational performance more effectively (Zhang et al., 2023). The implementation of digital technologies contributes to the optimisation of internal flows, the reduction of processing times and the increase of productivity, essential aspects for banking institutions operating in a regulated environment oriented towards operational efficiency (Ohinok & Hunka, 2023). In the banking environment, digital channels have recently developed, such as Internet banking, mobile banking, and financial applications that allow permanent access to remote banking services and contribute to increased user satisfaction and bank competitiveness (Bousrih, 2023).

Banks are increasingly exposed to complex digital transformations that have changed internal procedures and customer interaction and involve the integration of technologies such as artificial intelligence, advanced data analytics, cloud computing, blockchain and digital platforms. Digital technologies have profoundly transformed traditional banking services, radically changing both customer communication and internal banking processes (Osei et al., 2023). With the accelerated expansion of artificial intelligence in recent years, banks have not been unaffected by customer interaction automation processes, such as chatbots, automated scoring, fraud detection, or predictive analytics (Radenković et al., 2023). Recent studies show the immense potential of artificial intelligence to optimise banks' connections with customers through automation tools and data-driven decisions (Kalyani & Gupta, 2023).

Digitalisation affects various banking operations, and investments aim to increase competitiveness by implementing solutions based on artificial intelligence, blockchain, cloud computing, or big data analysis. In this way, financial institutions aim to optimise their internal control processes, reduce their operational costs and improve the quality of services

offered to bank customers. Fintech products are likely to improve banking efficiency by facilitating innovation and changing how banks operate, offering innovative, low-cost services that lead to increased efficiency and higher-quality services for customers (Sajid et al., 2023).

At least two perspectives require analysis of banking digitisation processes (Perić et al., 2021): first, optimising internal control and governance processes to streamline activities and reduce costs, and second, improving the quality of banking services for customers. Banking digitisation processes allow banks to develop banking services characterised by high flexibility and adaptation to the specific requirements of customers (Sesar et al., 2021). In this way, banking digitalisation has become a central element of banking strategy and has moved beyond its role as a mere technological tool. Banking institutions' need to quickly adapt to customers' demand for fast, continuous access to banking services drives massive investment in digital technologies. In this way, digital banking technologies are transformed from simple technical tools into true strategic elements of banks, capable of contributing to organisational development and banking sustainability (Ohinok & Hunka, 2023). A few years ago, the accelerated transition from traditional processes to digital ones was considered an "almost overnight" transition from classic to digital operations, which profoundly changes the organisational structure and banking relationships with customers (Sesar et al., 2021).

Although the literature abounds with studies highlighting the advantages of digital banking technologies, these benefits are associated with multiple challenges. Among the most important are amplified cyber risks, customer data protection, and operational resilience (Rodrigues et al., 2022). In a banking environment exposed to cyber risks, banks must continue to develop digital infrastructure and invest in system security to limit exposure to the risks associated with digital technologies (Wang et al., 2024).

The table below summarises the main advantages and disadvantages of banking digitalisation.

Table 1. Advantages and disadvantages of the banking digitalisation process

Advantages of banking sector digitalisation	Disadvantages of banking sector digitalisation
Simplification and acceleration of access to Internet banking and mobile applications.	High implementation and development costs for IT and telecommunications infrastructure.
Elimination of the need to visit branches for day-to-day banking operations.	The profitability of digitalisation investments may only emerge in the medium or long term.
Fast, real-time payments and fund transfers.	Reluctance of certain customer categories to adopt digital services.
Customers' access to information in their accounts and transactions.	Cyber risk requires high levels of data protection.
Diversification of banking services based on specific customer data.	Insufficient legislative regulations in certain jurisdictions.
Increasing customer satisfaction and loyalty through quality, personalised products.	Operational and managerial risks in the implementation of digital banking services.
Reducing operational costs and increasing efficiency.	Fierce competition between digital technology providers.

Higher profitability through the expansion of electronic services and cashless payments.	Decrease in traditional bank revenues.
Increased financial inclusion and easier access to banking services.	Reduced need for bank staff and physical branches.
Lowering risks associated with using cash, such as loss and theft.	The risk of high fraud amid cyberattacks.
Promoting an economy with as little cash as possible and supporting economic growth.	Differences between nation-states, with varying levels of development in the field.
Contribution to banking innovation and competitiveness.	High investment costs for the implementation of digital technologies.

Source: Adapted from Bousrih (2023) and Harchekar (2018)

Based on the literature above, banking digitisation can be linked to banks' desire to improve efficiency and reduce costs, even though it initially requires massive technology investments. Unfortunately, banking digitisation comes with sophisticated cyber risks and fierce competition between banks. From the customer's perspective, banking digitisation can help reduce bank visits and save time but also increases data security risks.

3. Research Method

Because the literature on banking digitalisation is extensive, analysing it is difficult, and there is a risk it may not capture essential aspects. For this reason, using specific software, such as VOSviewer, facilitates bibliometric identification of keywords and publication rates. The key search term was "bank digitalisation". The analysed studies were extracted from the ScienceDirect database, and only English-language documents were included. The data were collected on March 18, 2026. The initial publication interval analysed was 2003-2025, for which the number of published studies was examined. Second, attention was focused on the more recent period of 2022-2026, for which the publications and their keyword network were analysed on a yearly basis. The studies were filtered to include only those related to business, management, accounting, economics, econometrics, and finance. For each of these years, a separate analysis of 1000 studies was carried out.

The next stage of the research involved using VOSviewer software to analyse links between the published studies and identify the main thematic areas addressed in the existing literature. The functionalities of the software allow the generation of co-occurrence networks of keywords from the analysed papers and the construction of related thematic clusters. In this way, the main research directions, as well as the emerging ones, can be highlighted, and the insufficiently explored themes can be more easily identified. The processing capabilities of the VOSviewer software contribute to the development of an objective perspective on the evolution of the banking digitalisation literature and its main trends.

This study combines descriptive and bibliometric analysis, enabling both quantitative identification of published studies and keyword networks and qualitative interpretation and contextualization of the raw data through explanations and descriptions of the observed trends.

Combining descriptive and bibliometric analysis increases the likelihood of accurately identifying trends in the literature and its relevant aspects in the field studied: banking digitisation.

4. Bibliometric Analysis

Bibliometric analysis is a quantitative method used to examine and evaluate scientific literature in a particular field of research. Using bibliographic indicators such as the number of publications, citations, keyword occurrence frequency, or relationships between authors and articles, this method enables the identification of trends, patterns, and the impact of research in each field. Thus, bibliometric analysis provides a systematic perspective on the evolution of scientific knowledge and facilitates the understanding of how academic literature develops over time (Rousseau, 2014).

The use of bibliometric analysis software allows the examination of a substantial volume of data and studies, based on which the intellectual structure of a research area can be created. Bibliometric techniques support the examination of the performance of publications, the identification of co-authorship networks and the co-occurrence of keywords. In this way, influential authors and institutions, as well as the main and emerging research themes, can also be identified, leading to a clearer understanding of the evolution of a scientific field. Bibliometric analysis also produces results that are less influenced by subjectivity and are reproducible when examining academic literature. Unlike traditional narrative reviews, which can be influenced by subjective interpretation, bibliometric methods rely on quantifiable indicators and systematic data analysis procedures. Therefore, this method is often used to map research fields, identify gaps in the literature, and guide future research directions (Passas, 2024).

Following the data collection process, a significant volume of publications in this field was identified, highlighting the growing interest of the scientific community in the digitalisation of the banking sector. Thus, 3632 articles were identified for 2026; 3634 for 2025; 2770 for 2024; 2128 for 2023; and 2055 for 2022.

Figure 1 shows the evolution of the number of articles published on banking sector digitalisation between 2003 and 2026. An increase in the number of studies is observed in the period analysed, especially in recent years. The increase in studies from 149 in 2003 to 3634 in 2025 shows growing interest in the field. The analysis of the 2003-2025 publication period shows several stages of development in the banking digitisation literature. During 2003–2012, the number of articles remained relatively low, with moderate fluctuations ranging from approximately 149 to 201 publications, reflecting limited interest in banking sector digitalisation. In the period 2013-2017, there was a moderate increase in published studies, from 210 to 642, which denotes a gradual consolidation of the field of banking digitalisation. Starting in 2018, the growth rate became much more pronounced, with publications increasing from 957 in 2018 to 3634 in 2025, indicating a considerable intensification of academic interest. A slight stagnation can also be observed during the period 2021–2023, followed by strong growth in 2024 and 2025.

This evolution can be explained by the accelerated development of digital technologies, the expansion of fintech solutions and the increasing importance of digital banking. Also, the context generated by the COVID-19 pandemic has contributed to the acceleration of digitalisation processes, leading both financial institutions and researchers to pay increased attention to this field.

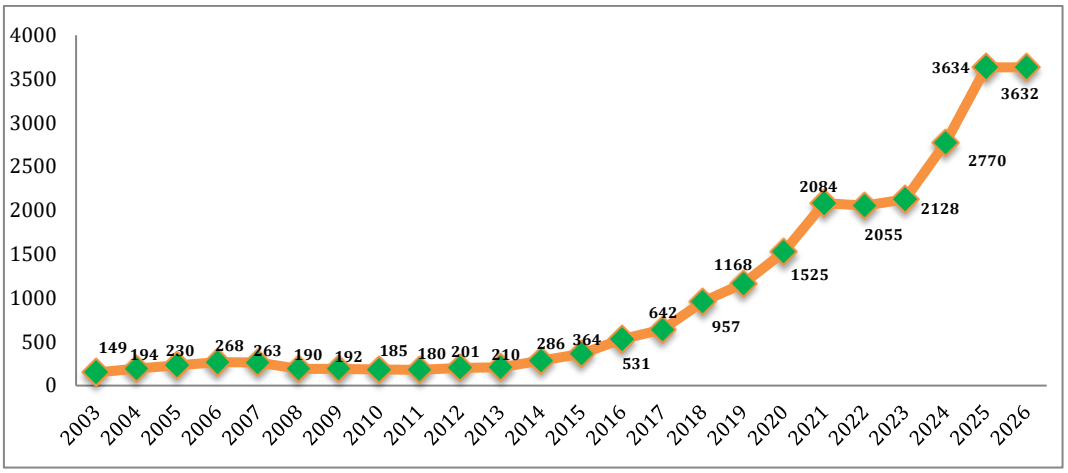

Figure 1. Evolution of the number of articles regarding banking sector digitalisation (2003–2026)

Source: authors' processing

Of the 24038 publications identified during the analysed period, research articles are the predominant category, accounting for 21042 papers (approximately 82.9%). These are followed by book chapters, with 1309 publications (around 5.5%), and review articles, totalling 639 papers (approximately 2.5%). Short communications also make up a smaller share, with 215 publications (approximately 0.9%), as do encyclopedia entries, with 139 papers (around 0.6%). The remaining document types, including editorials, book reviews, correspondence, conference papers, and other forms of publications, are grouped into the category "other types", totalling 694 papers, which represents approximately 7.6% of the analysed dataset. Figure 2 shows this distribution.

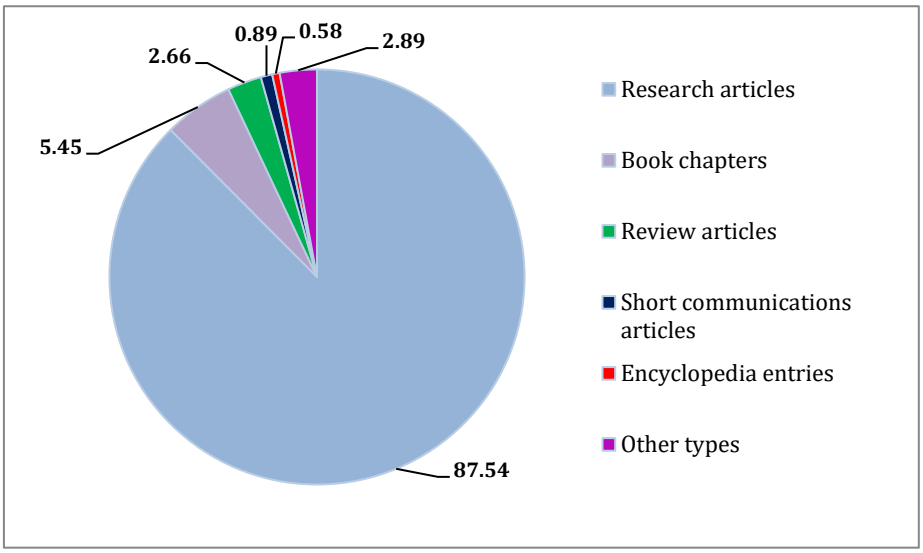

Figure 2. Distribution of publications by document type (2003–2026)

Source: authors' processing

The first stage of analysis was represented by the titles of the journals in which the studies were published. The most influential journal in this regard is "Technological Forecasting and Social Change" with 1111 articles, followed by "Telecommunications Policy" (806 articles) and "Finance Research Letters" (781 articles). Other journals in which numerous studies have been published are "Journal of Business Research" (734 articles), "International Review of Economics & Finance" (473 articles) and "International Review of Financial Analysis" (455 articles). An analysis of the distribution of studies reveals that articles were published across a wide range of journals from various fields, including technology, economics, and public policy, such as "Technology in Society", "Cities" and "World Development". Publications in technical and social spheres show that the term banking digitalisation is used not only in a strictly economic context but also from other perspectives, suggesting the subject's complexity.

For each year in the 2022-2026 analysis period, the facilities of the VOSviewer software were used, and at least six occurrences of the selected keywords were analysed in detail. The figure below presents the network of terms specific to 2022.

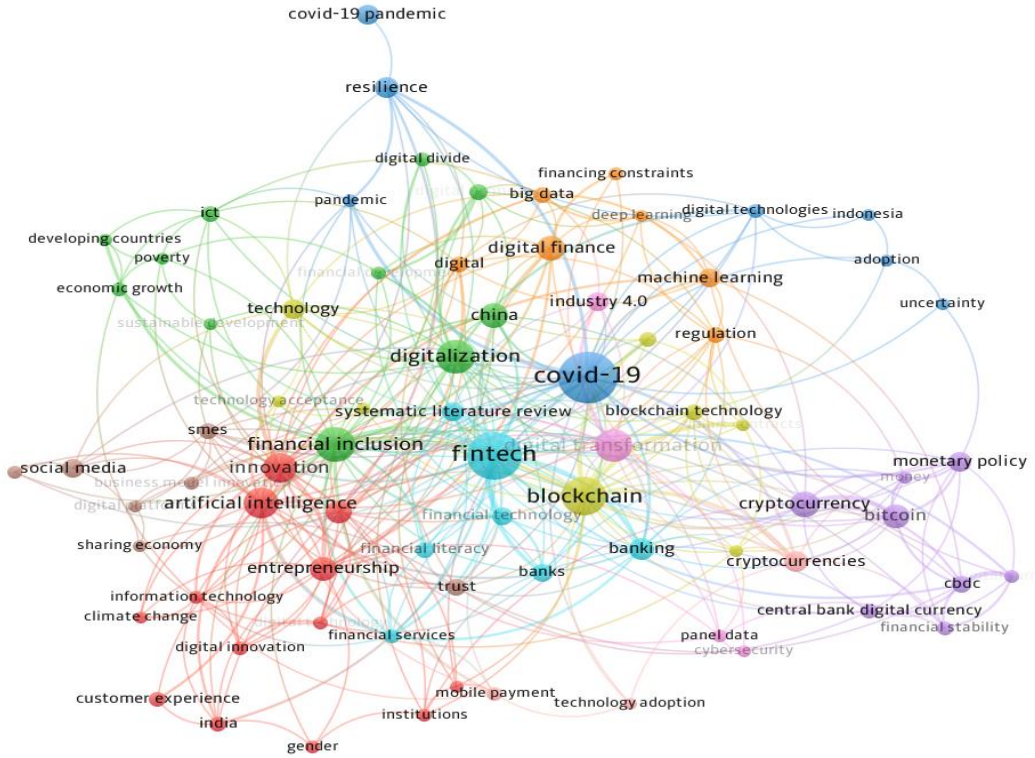

Figure 3. Network of concepts in the field of banking digitalisation in 1000 studies (2022)

Source: authors' processing from VOSviewer

Six clusters were set up based on the key terms associated with the published research. The first cluster (marked in red) contains studies focused on emerging technologies

and financial innovation. It includes concepts such as “artificial intelligence”, “innovation”, “entrepreneurship”, “digital innovation” and “financial services”. Favoured themes focus on how modern technologies and artificial intelligence are transforming financial services, banking customer experiences and entrepreneurship. The studies are related to digital inclusion and the development of new business models in the financial sector.

The studies in the second cluster (marked in green) focus on digitisation processes and how they influence economic development. This cluster includes terms such as “digitalisation”, “technology”, “ICT” (Information and Communication Technologies), “economic growth”, “developing countries” and “financial inclusion”. The links between digitalisation and economic growth, income and reducing poverty are addressed, particularly in developing economies.

The third cluster (marked in blue) of the 2022 analysis emphasises the central theme of the COVID-19 pandemic and its impact from the perspective of banking-sector digitalisation. Highlighted terms include “COVID-19”, “pandemic”, “resilience”, “uncertainty” and “adoption”. The studies in this cluster analyse how the pandemic accelerated digitalisation, influenced consumer behaviour, and led financial institutions to adopt digital technologies more quickly.

The fourth cluster (marked in yellow/orange) includes more technical terms directly associated with the banking field, focusing on advanced digital technologies and their applications in finance. It includes concepts such as “digital finance”, “machine learning”, “big data”, “industry 4.0” and “regulation”. The studies in this cluster focus on the use of data analytics technologies and artificial intelligence in financial processes, as well as the regulatory aspects associated with these technologies.

The fifth cluster (marked in purple) centres on financial innovations in cryptocurrencies and new forms of digital currencies. Terms such as “cryptocurrency”, “bitcoin”, “central bank digital currency” and “monetary policy” underline researchers’ interest in the impact of these innovations on the financial system and monetary policies.

The last cluster (marked in turquoise) focuses on the concept of “fintech”, which could be considered the network’s core element. It is intensely interconnected with terms such as “banking”, “blockchain” and “financial technology”, indicating that fintech represents a focal element around which most research in this field is constructed.

The following graphical representation shows the situation in 2023, for which six clusters were analysed.

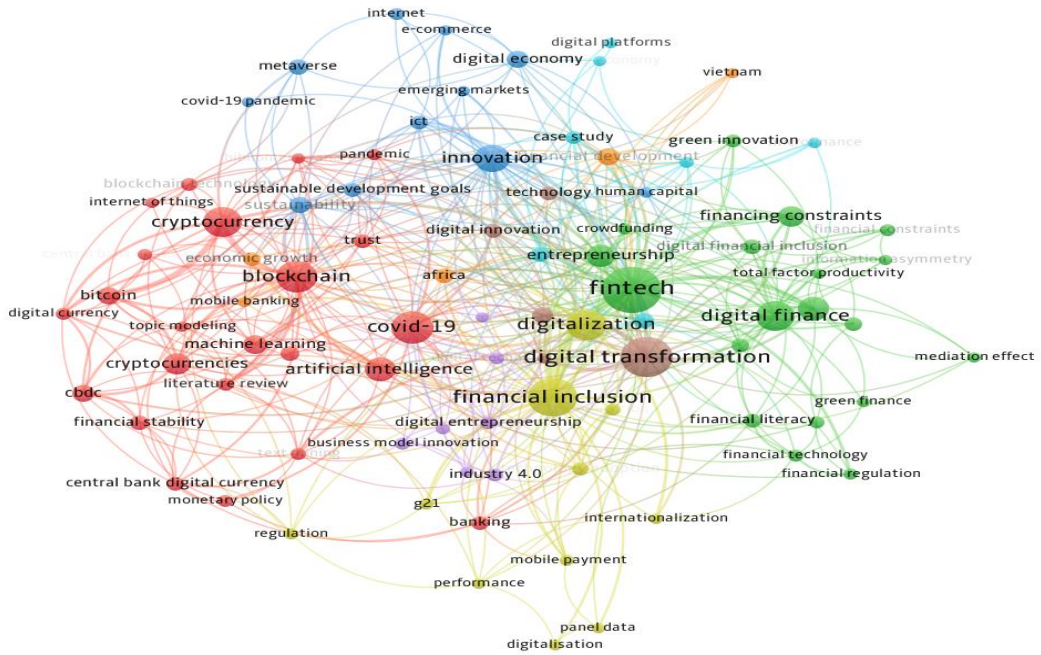

Figure 4. Network of concepts in the field of banking digitalisation in 1000 studies (2023)

Source: authors' processing from VOSviewer

The first cluster (marked in red) brings to the fore terms associated with cryptocurrencies and their connected technologies. It includes concepts such as "cryptocurrency," "bitcoin," "blockchain," "digital currency," and "central bank digital currency". Studies in this cluster analyse the impact of cryptocurrencies on financial stability, their role in the monetary system, and their implications for monetary policy, including technological and financial advances during the COVID-19 pandemic. The cluster highlights the placement of artificial intelligence as an important term for links with technologies such as "machine learning" and "Internet of Things".

The second cluster (marked in green) reveals the dominant role of terms associated with "fintech", such as "digital finance", "digitalisation", "financial technology", "financial inclusion," and "financial literacy." The topics addressed by the studies in this cluster concern the role of fintech in entrepreneurship, green finance, financial literacy or financing constraints.

The third cluster (marked in yellow) is associated with "financial inclusion" and "digital transformation". It is a small cluster, placed next to the one described above, and shows how financial inclusion is created and how regulation, internationalisation, performance, and mobile payment are influenced by digital transformation.

The central element of the fourth cluster (marked in blue) is innovation closely related to the digital economy. Terms such as "innovation", "digital economy", "e-commerce", "internet", "emerging markets" and "ICT" (Information and Communication Technologies) explores how markets, especially emerging ones, are influenced by the digital ecosystem.

Literature on the fifth cluster (marked in purple) is a small cluster with terms centred on "industry 4.0", "digital entrepreneurship" and "business model innovation", placed in the immediate area of the term artificial intelligence in the red cluster and shows the development of digital businesses under the impact of technologies.

Another relevant cluster (marked in orange) is also small, with words from the sphere of "digital innovation" and "technology" associated with economic growth and financial development.

The analysis of the specific studies for 2024 is graphically delimited by the figure below.

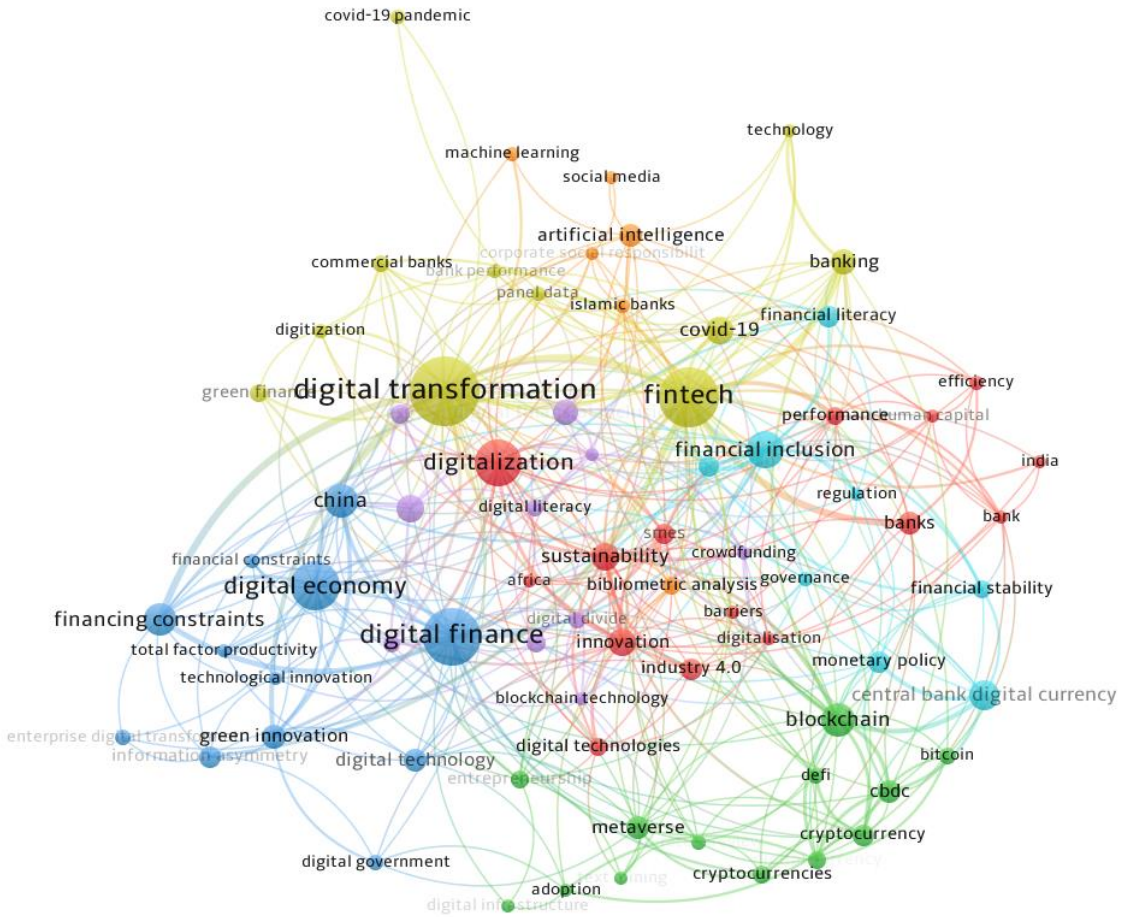

Figure 5. Network of concepts in the field of banking digitalisation in 1000 studies (2024)

Source: authors' processing from VOSviewer

The first cluster (marked in yellow) is developed around the concepts of "digital transformation" and "fintech". These concepts are essential to the banking sector, showing how digital transformation influences banking activities and contributes to the development of modern financial services.

The second cluster (marked in blue) focuses on the "digital economy" and "digital finance", dominant terms around which other terms associated with financial digitalisation also revolve, such as "technological innovation", "green innovation" or "digital technology", showing a varied typology of facets of financial technologies and digitalisation.

The third cluster (marked in green) brings to the fore technical elements such as "metaverse", "blockchain", "cryptocurrencies" or "Central Bank Digital Currency CBDC". This association highlights financial innovations based on modern technologies and shapes trends in the expanding literature.

The fourth cluster (marked in red) connects "digitalisation", "digital literacy", "digital technologies", "innovation" and "sustainability", thus showing the contributions of digitisation to sustainable development.

The fifth cluster (marked in turquoise) underlines the most important term, "financial inclusion", which relates to "regulation", "governance", "monetary policy" and "financial stability". The literature on these keywords highlights the role of digitalisation in financial inclusion, without neglecting the role of regulation, governance and financial stability.

At the centre of the last small cluster (marked in purple) are "digitalisation", "digital literacy", and "digital divide", which can be considered concepts connected to the rest of the clusters and which emphasise the role of digital skills in human development.

For 2025, the analysis of the six clusters is presented in the following figure.

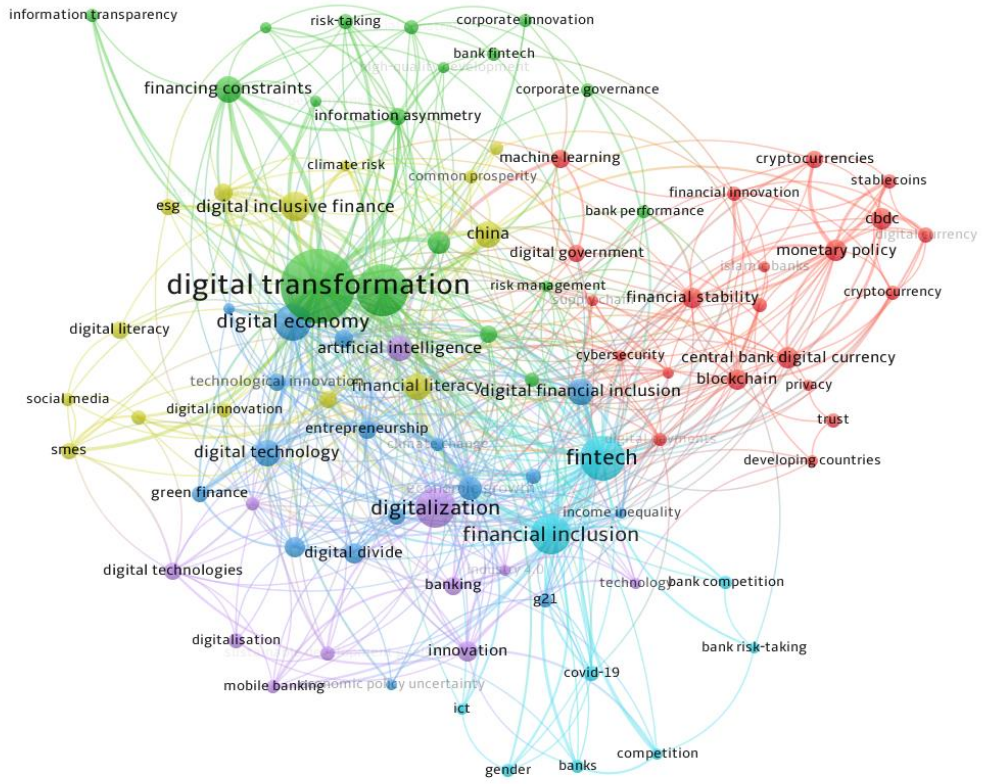

Figure 6. Network of concepts in the field of banking digitalisation in 1000 studies (2025)

Source: authors' processing from VOSviewer

The first cluster (marked in green) is centred on the concept of "digital transformation", connected with "fintech bank", "financial constraints", "information asymmetry" or "information transparency". Studies in this cluster show the role of digital transformation and fintech in reducing financial constraints and information asymmetry, as well as their contribution to corporate innovation and governance.

The second cluster (marked in red) is balanced, given the dominant role of some keywords, without highlighting any as focal. The terms "financial stability" and "monetary policies" are associated with innovative and modern concepts, such as "central bank digital currency", "cryptocurrency", "blockchain" or "machine learning". In this way, studies that analyse the role of innovative technologies in financial stability or monetary policy are highlighted.

"Digital economy" is the dominant term of the third cluster (marked in blue), which is associated with expressions such as "digital technology", "digital divide", "technological innovation" or "green finance". The studies that are part of this cluster bring together research on how the digital economy is interconnected with entrepreneurship, technological developments and green finance.

The yellow cluster is peripheral, with less significant terms, and its concepts revolve around "digital literacy", "digital innovation", and "financial literacy" connected with "digital inclusive finance".

At the heart of the turquoise cluster are two dominant and significant concepts, often used in studies and relevant as network nodes – "fintech" and "financial inclusion". Emerging subthemes such as "income inequality", "competition", "gender", "ICT", "bank-risk taking" revolve around these themes. The association of these terms suggests that financial technologies are analysed from the perspective of their role in financial inclusion, banking, competitive risks and access to banking services.

The purple cluster is an important one and contains the significant "digitalisation" node, which focuses on the role of digital technologies, mobile banking services and innovation.

For the year 2026, the thematic map of keyword co-occurrence is shown in the figure below.

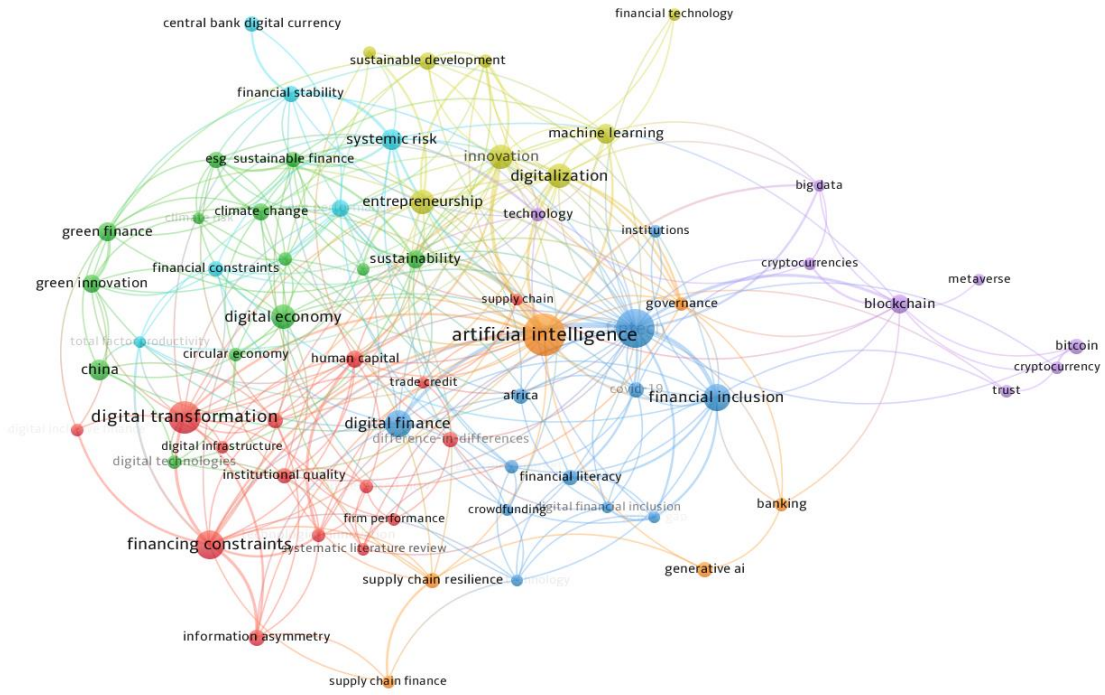

Figure 7. Network of concepts in the field of banking digitalisation in 1000 studies (2026)

Source: authors' processing from VOSviewer

In 2026, the dominant term with the largest network node is "artificial intelligence", which belongs to the orange cluster, around which the other clusters and the links between studies develop. The yellow cluster groups specific digitalisation terms, such as "machine learning", "innovation", "financial technology", "entrepreneurship" and "sustainable development". The studies published in this cluster highlight the role of digitalisation in business development and in the creation of sustainable economic models.

The blue cluster highlights the associated terms "fintech" and "financial inclusion", around which "digital finance", "financial literacy", "crowdfunding" or "resilience" are centred. Studies that group these terms describe the role of financial inclusion under the impact of fintech and emphasise the role of financial literacy and digital finance.

The green cluster centres around the terms "digital economy", "sustainable finance", "sustainability" and "green finance". These are alongside other terms in sustainable development, suggesting links between the digital economy and green innovation, as well as support for sustainable development.

Another striking cluster, the red one, is dominated by the term "digital transformation", around which associated terms are grouped: "digital infrastructure", "institutional quality", "information asymmetry", "bank performance", "financing constraints", "human capital", "supply chain finance" or "supply chain resilience". The studies of this cluster focus on the role of digital transformation in various areas, such as those related to company performance, human capital, resilience and supply chain financing,

The purple cluster is developed around the term “blockchain” and associated concepts, such as “big data”, “cryptocurrencies”, “trust”, “metaverse” or “bitcoin”. Studies in this grouping of terms present the issues of cryptocurrencies, blockchain technologies and their integration into more complex systems, such as those related to the metaverse, as well as sensitive topics related to trust.

Some marginal terms belong to the turquoise cluster, where the concept of “systemic risk” is linked to “financial stability”, highlighting the role of digitalisation in bank management from a financial perspective.

We developed 6 clusters for each year to ensure comparability of the networks and the co-occurrence of key terms from one year to another. We observed both a gradual shift in research directions and changes in cluster structure. The relative importance of some fundamental concepts is also different from year to year. The common concepts encountered are the following: “fintech”, “digitalisation”, “digital transformation”, “financial inclusion”, “blockchain” and “artificial intelligence”. These are the major themes of the literature analysed and connect the remaining subfields. The number of connections between terms is high in each of the years analysed, showing a high degree of interconnectedness of studies and terms.

In 2022, the first year of analysis, key terms relate to the COVID-19 pandemic and its impact on financial institutions. The research also focuses on the digitalisation of banking, fintech and artificial intelligence. Surprisingly, the latter concept appears in studies from 2022, when the field was in an early phase of practical and academic exploration.

In 2023, studies focused on emerging financial technologies, represented by cryptocurrencies and associated terms – blockchain, the digital economy and digital transformation. Concepts related to COVID-19 are much less circulated in the year under review.

The year 2024 brings to the fore terms specific to digital transformation and the digital economy, connected to adjacent themes related to sustainability, digital literacy and governance. The research extends into related fields, with distinct and well-defined clusters.

In 2025, the keyword co-occurrence network is dominated by digital transformation, which relates to financial stability, monetary policy, banking sector performance and financial inclusion. The shift of digitalisation into a strategic factor in the evolution of banking systems is evident.

For 2026, only research published through mid-March was analysed, and although the data are partial, the importance given to concepts associated with artificial intelligence is increasing. This appears to be driving a significant volume of related studies across digital transformation, sustainability, green finance, blockchain, digital infrastructure, and systemic risk management.

The dynamics of research in the period 2022-2026, which derives from the core of bank digitalisation, show several trends in the studies of those oriented towards digitisation as an effect of the paradigm shift in digital technologies, especially after the experiences of the COVID-19 pandemic. Added to this were the more recent implementations of artificial intelligence in the banking field. Banking digitalisation has become an important factor in the resilience and sustainability of financial institutions, as a modulating factor of banking strategy.

The table below presents the most important terms associated with banking digitalisation in studies published in 2022-2026 in the ScienceDirect database. These words were extracted from terms mapped by VOSviewer. The frequency of the appearance of the

terms shows their relative importance in the literature studied. In this table, the abbreviation "freq" refers to the frequency of occurrence of a key phrase, while "link" represents the total link strength.

Table 2. Evolution of 30 keywords during the period 2022–2026

Year	2022		2023		2024		2025		2026	
Keywords	Freq.	Link.	Freq.	Link.	Freq.	Link.	Freq.	Link.	Freq.	Link.
Artificial Intelligence	29	34	24	16	15	12	22	28	52	40
Banking	16	22	10	12	17	27	20	32	8	7
Banks	12	15	-	-	21	32	7	8	5	6
Bitcoin	19	19	14	22	9	9	-	-	9	5
Blockchain	44	42	40	56	29	39	15	17	13	18
CBDC (Central Bank Digital Currency)	20	28	31	36	38	40	32	32	9	3
China	20	12	25	25	28	28	23	23	16	8
Covid-19	85	43	48	30	28	24	9	12	9	9
Cryptocurrency	37	37	55	62	23	30	19	22	14	14
Digital Currency	7	13	8	17	10	16	9	11	-	-
Digital Economy	10	11	14	10	54	37	41	37	21	13
Digital Finance	20	16	36	30	70	48	74	66	24	16
Digital Technology	7	11	15	18	25	24	23	24	14	17
Digital Transformation	32	24	59	57	98	77	138	101	33	23
Digitalisation	40	35	44	46	55	48	56	38	21	31
Entrepreneurship	19	19	21	26	10	13	13	24	20	23
Financial Inclusion	36	39	54	74	33	40	47	72	25	29
Financial Stability	8	8	11	10	10	15	15	24	10	15
Financing Constraints	7	4	19	19	27	27	23	27	27	28
Fintech	61	66	75	87	75	92	57	91	45	57
Green Finance	-	-	6	4	10	7	10	16	14	12
Industry 4.0	13	8	9	9	13	14	-	-	-	-
Information asymmetry	-	-	6	8	14	10	12	16	10	10
Innovation	27	31	30	48	20	30	15	16	20	31
Machine Learning	13	11	16	16	7	4	13	9	15	20

Year	2022		2023		2024		2025		2026	
Sustainability	18	19	13	18	21	33	15	18	12	22
SMEs (small/medium -size enterprises)	10	12	13	17	12	20	10	14	-	-
Systematic Literature R.	13	19	-	-	-	-	8	13	7	9
Technology	14	16	10	8	6	8	-	-	8	15
Technological Innovation	-	-	8	6	6	8	11	16	8	13

Source: Authors' own processing using data extracted from the ScienceDirect database (2026) with the support of VOSviewer software

Based on the information in this table, some important trends can be delineated. A major term is "fintech", which has very high values throughout the analysed period, both in terms of frequency and link strength. Another important aspect concerns the evolution of the keywords "digital transformation" and "digital finance", which generate a significant number of related research. The general term "digitalisation" is also stable over the period under review and indicates the continuous importance of digitalisation processes.

A particular evolution is the term "artificial intelligence", significant since 2022, less visible in the following years, and which seems to coalesce around it the research of 2026, based on the data available to date. Studied since the '50s (Mucci, 2024), artificial intelligence has become an omnipresent reality in the contemporary period, along with various research themes associated with banking digitalisation.

A distinct subfield of research targets cryptocurrencies and blockchain technology. The terms "blockchain", "bitcoin", and "cryptocurrency" show high values in the early years analysed, with the first study dating back to October 2008 (Kaminskaite, 2026). This field has attracted many authors, who address not only the classic aspects of digital assets but also links to newer CBDCs (Central Bank Digital Currency) and the metaverse as a modern environment of emerging technologies.

The term "Covid-19", which recorded very high values in 2022 as an external factor influencing bank digitalisation, declined progressively in relevance in subsequent years. This trend indicates that, as the pandemic's impact decreased, research interest shifted toward fundamental, long-term topics such as digitalisation, innovation, and financial inclusion.

Several sustainability-related terms seem to dominate the current orientation of research on banking digitalisation. Concepts such as "financial inclusion", "sustainability" and "green finance" indicate a distinct orientation toward sustainable development and the integration of ESG criteria within the financial sector. It is interesting that emerging concepts appear in the network of terms, such as "information asymmetry" and "financing constraints", that focus on market efficiency and access to financial resources.

Interdisciplinary research is associated with concepts such as "innovation", "entrepreneurship" and "digital economy", which demonstrate the strong relationship between technological progress and economic development.

The analysis helped clarify banking digitalisation as an essential factor in the current banking business model. Associated concepts, such as financial technology, digital finance and digital transformation, are essential for financial institutions. They are forced to adapt

their business model to the new digital realities, to invest massively in technology and automation, in order to offer their customers the expected services. Artificial intelligence has also transformed the banking strategy, oriented towards automated decision-making and a focus on the customer's personalised needs. Digitalisation and artificial intelligence reduce costs and optimise internal processes, but also create significant cyber risks. A new trend taking shape is the idea that new digital technologies and artificial intelligence could support sustainability and green finance in banking. Currently widely circulated terms such as blockchain, cryptocurrencies and CBDC (Central Bank Digital Currency) can be found in the banking digitisation literature and show the continuous transformations taking place in monetary systems and financial transactions. Financial institutions and regulatory authorities must carefully assess the opportunities and risks associated with these technologies, ensuring balanced integration in accordance with the existing legislative framework.

5. Conclusions

Methodologically, the present study uses the ScienceDirect database, from which studies published between 2022 and 2026 on banking digitisation were extracted. These studies were qualitatively analysed, and then technical procedures of scientific mapping and bibliometric mapping using VOSviewer software were applied to them, in order to identify the key terms of the research and the existing literature networks. The literature on banking digitalisation has expanded in recent years, especially after the pandemic, when digital technologies took off remarkably. Topics related to banking digitalisation have diversified and expanded into areas such as artificial intelligence and related fields.

The analysis highlighted several areas of development in the literature on banking digitalisation, including digital transformation, fintech, artificial intelligence, blockchain, cryptocurrencies, financial inclusion, sustainability, and the performance of banking institutions. Even classic banking topics related to banking performance or efficiency have been permeated by the trendy topic of digital technologies.

The interdisciplinary character of the field and the prevalence of the theme in financial journals are noted, as well as its presence in specific journals of technology, management, economics, and innovation. Such a diversity of sources in which topics related to digital technology are found provides arguments for the special importance of the theme and its topicality.

From a practical perspective, this study can help researchers visualise the network of terms related to banking digitalisation, as well as banking regulators and bank management, who can better understand the complexity of banking digitalisation and its associated risks and benefits. The present research highlights the rapid transition of banking digitalisation from a simple technological tool to a central element of banking strategy.

The study has limitations related to its reliance on studies published only in the ScienceDirect database, without including others, such as Scopus or Web of Science. Second, the timeliness of the data represents another limitation. Given that the analysed field is dynamic and continuously developing, new publications emerge constantly. In this context, the present analysis is limited to studies available up to March 18, 2026, meaning it does not capture subsequent developments. Third, the process of selecting and filtering data within the analysis conducted using VOSviewer involves a certain degree of subjectivity. The establishment of minimum occurrence thresholds for keywords or the exclusion of certain terms was based on the author's decisions, which may influence the final structure of the analysed network.

Future research could integrate studies from other databases, such as Scopus and Web of Science, and diversify search criteria to produce more reliable and robust results. The use of other bibliometric analysis software, such as NVivo or the R Bibliometrix package, could also lead to defining results for field research.

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