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Systematic review of a business model using blockchain technology for the use of digital money in mass centers

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ABSTRACT

In recent years, commercial transactions have experienced a radical change in the way goods and services are purchased. Payments with electronic and digital money are increasing dramatically compared to payments with physical money. Likewise, money using blockchain technology is marking disruptive milestones in transactions, especially in cross-border payments, showing many benefits, such as speed, lower costs, and security. The COVID-19 pandemic has shown the entire world the potential and possible development horizon of digital money, especially cryptoassets, in commercial transactions, as well as the risks associated with this technology. This has exposed the problem and need for a commercial model with blockchain technology for use in mass centers, which allows for the widespread and democratization of blockchain technology in mass commercial transactions. The methodology used is PRISMA. The objective of this article is to conduct a systematic review of the literature on digital money with blockchain technology for use in mass marketing centers. Finally, the results are presented, where the commercial model based on blockchain must consider security criteria, technology, legal aspects, and sociocultural barriers. Incorporate the interaction between electronic money, central bank digital currencies (CBDCs), and cryptoassets, as well as a decentralized technological platform for direct digital commerce. This implies that the model must consider these criteria in its design, implementation process, and the platform it supports.

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1. INTRODUCTION

In recent years, commercial transactions involving the purchase of goods and payments for services have undergone a radical change. While electronic and digital payments are increasing, those made with physical cash are decreasing [1]. However, when payments are made electronically, they are charged to the balance in personal accounts at traditional banks or to credit lines established by the same bank.

In this regard, when transactions are cross-border and require changing banks and currencies, costs for the user increase, making them very onerous [2]. This is where digital currency or cryptocurrency under blockchain technology becomes important, since national and international financial transfers are lower cost, faster and more secure [3], [4]. This decrease in transaction costs experienced when carrying out transactions with digital money with blockchain technology is a very important aspect to study in order to develop a proposed model, so that companies can adopt blockchain technology, as well as virtual platforms

to enhance, extend and boost the benefits and effectiveness of implementing social currencies in regional environments [3].

To understand blockchain technology, we must keep in mind that it is an innovative system for recording and managing information in a secure, transparent, and decentralized manner, thanks to its structure of cryptographically linked blocks that guarantee data integrity and immutability [5]. By operating through a distributed network and consensus mechanisms, it eliminates intermediaries and reduces the risk of manipulation, increasing user trust. Blockchain also enables secure and private transactions through cryptographic techniques [5]; in mobile networks, this technology offers advantages when managing critical information, such as authentication and resource allocation in an efficient and decentralized manner, protecting privacy and improving security compared to the vulnerabilities of centralized systems [6]. However, the widespread use of digital money with blockchain technology is influenced by multiple factors that determine its acceptance, such as subjective norms, social influence, attitude, utility, ease of use, and perceived security [7], [8]. Other factors to consider include: lack of a regulatory legal framework, limited knowledge, resistance to change, technical aspects (scalability, interoperability, security), data protection, and privacy [9].

For this reason, the objective of this article is to conduct a systematic literature review (SLR) of digital money with blockchain technology for use in mass marketing centers, considering for this purpose, the facilitating and limiting factors in the intention to adopt digital money [10]. As well as the key elements of this technology such as: economic, security and decentralization [4]. Using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) methodology for the bibliographic review.

The systematic literature reviews (RSL) regarding electronic money, digital money, cryptoassets, and blockchain technology considers the advantages and disadvantages of each. As well as the business models for using digital money that have been developed in some ecosystems, and then presents the results of the study regarding trends, problems and challenges, as well as conclusions regarding the research questions. Based on these results, an initial proposal is made about the digital money ecosystem and the interaction that has occurred between physical money, electronic money, and digital money with blockchain technology, as a medium of exchange for transactions of goods and services.

It should be noted that similar reviews have been found that are oriented to other thematic fields such as: adoption of electronic money [11]; energy consumption in cryptoasset mining; security and cybersecurity of [12] FinTech systems and networks [13]; use of blockchain in accounting practice and research; cybersecurity risks of [14] near-field communication (NFC) technology in payment solutions [15]. Therefore, this systematic review is unique in the field of digital money use in mass centers.

The article follows a solid methodological structure, beginning with a systematic literature review using the PRISMA approach, focusing on the use of blockchain-based digital money for mass-market centers. To this end, it defines the primary and secondary research questions, applying rigorous eligibility criteria and including validated and relevant articles. It then develops a bibliometric analysis using tools such as VOSviewer and Bibliometrix, which facilitates a visual and quantitative understanding of the current landscape. Finally, it proposes a conceptual model that integrates different types of money (physical, electronic, and digital), a decentralized technological platform, and end-user interaction, thus establishing a comprehensive architecture adapted to the changing demands of the market and society.

2. METHODOLOGY

For this research, a systematic review of the literature related to the widespread use of digital currency with blockchain technology in large-scale centers was conducted. The PRISMA methodology was used for the entire bibliographic review process; a bibliographic analysis was also performed to complement the study, using a quantitative approach. This methodology was chosen because it fits the research developed and yields some important results, as indicated by [16]. However, other methodologies exist, such as Kitchenham and Charter in [17], which are also used in systematic review studies. Figure 1 presents the flowchart of the PRISMA methodology used in this RSL.

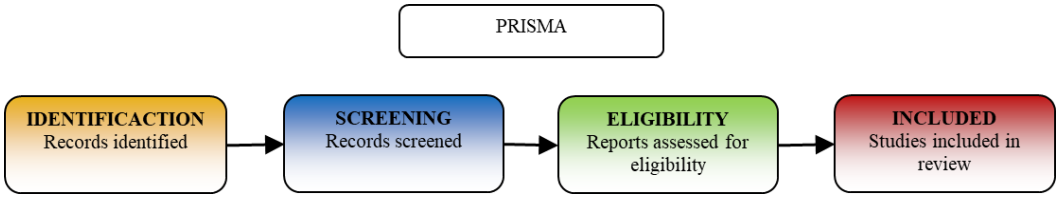

Figure 1. PRISMA methodology process

2.1. Type of study

This study is a systematic review of the literature, which constitutes a tool used to evaluate and analyze all available research related to a research question, a thematic area or a phenomenon of particular interest [18]. This methodology contains a systemic structure that covers a set of items, thus ensuring that the research clearly answers the research questions [19]. This systemic review of the literature on digital money with blockchain technology allows us to identify the most relevant primary articles, synthesize and extract the main data to have a broad view of the state of the subject under investigation [20], [21].

2.2. Methodological approach

The methodological approach used is PRISMA, a method created in 2009 to help authors of systematic reviews and meta-analyses improve their reporting [18]. This methodology has provided a comprehensive overview of the state of research literature regarding digital money using blockchain technology, including its variants of electronic money and cryptoassets. Table 1 of the PICO question, which identifies the main search terms with their respective synonyms, which will allow us to more precisely narrow down the search criteria.

Table 1. Peak question

Factor	Description	Search Terms	Synonyms
Problem	Business model	Business model Commercial transactions Digital clients Digital users	"business model" or "commercial transactions" or "digital clients" or "digital users"
Intervention	Use of digital money	Digital money or cryptoasset Electronic money	"digital money" or "cryptoassets" or "electronic money"
Comparison	Forms of digital money used in transactions	Physical money or Electronic money or Digital money	"physical money" or "electronic" money" or "digital money" or "blockchain"
Objective	Use of digital money in commerce, markets and business	Trade, markets and business	"trade" or "markets" or "business"

2.3. Research questions

During the systematic review process, several research questions were formulated, related to the research topic. The first of these questions corresponds to the main research question and the following three to the secondary ones. Table 2 presents the research questions on which the systematic review will focus.

Table 2. Research questions

Codes	Questions
RQ	What business models would facilitate the use of digital money with blockchain technology?
RQ1	What are the factors that facilitate the use of digital money with blockchain technology?
RQ2	What types of currencies facilitate the use of digital money with blockchain technology?
RQ3	What are the mass-market shopping centers that facilitate the use of digital money with blockchain technology?

2.4. Eligibility criteria

Eligibility criteria were also developed. These criteria are grouped into inclusion and exclusion criteria. These criteria allowed us to identify, out of the 464 articles, the most relevant to the research topic. Table 3 shows the eligibility criteria, both inclusion and exclusion, used to determine the final articles for evaluation:

Table 3. Eligibility criteria

Criteria	Criterion Codes	Item Description
Inclusion	CI1	Published between 2018 and 2024
	CI2	Journal, Book chapter, Conference paper,
	CI3	Published in English
	CI4	With results validated in real-life environments
Exclusion	CE1	Not related to digital money
	CE2	Not related to the payment of goods and services with digital money
	CE3	Not related to mass marketing
	CE4	Published articles that do not have an impact factor
	CE5	That they do not contain "electronic money" or "digital money" as keywords.

2.5. Sources of information

For the information search, reliable databases were used, from indexed sources that are well-known in the research and academic community. These sources of information are shown in the Figure 1. The main search engine being Scopus, which concentrates several databases such as: SciELO, ScienceDirect, IEEE, Dialnet, among others.

2.6. Search strategy

The search strategy for the systematic review of the literature was carried out with the following search string:

(ALL ("business model" OR "Commercial transactions" OR "digital commerce" OR "digital clients") AND ALL ("implementation digital money" OR "implementation of crypto assets" OR "electronic money") AND ALL ("electronic money" OR "digital money" OR "crypto assets" OR "physical money") AND ALL ("trade" OR "markets" OR "business")).

2.7. Study selection process

The study selection process is a critical phase of systematic review methodology. Its objective is to identify, evaluate, and carefully select relevant articles that directly address the research questions. This process involves the following four stages:

2.7.1. Identification

The identification stage consists of an initial, exhaustive search for potentially relevant scientific articles. For this purpose, a clear and precise search string is defined, using keywords and specific terms related to the research topic [16]. This search is carried out in indexed and recognized databases, such as Scopus, ScienceDirect, IEEE, Dialnet, among other sources. The objective in this phase is to collect as many articles as possible that match the defined terms.

2.7.2. Detection

The screening stage involves performing an initial screening or preliminary filtering of the articles identified in the previous phase. Here, the titles, abstracts, and keywords of the articles are quickly reviewed, seeking to establish a clear and direct relationship with the search string and the research objectives [16]. During this stage, an initial set of criteria is applied for the first time, eliminating articles that are clearly irrelevant or outside the scope of the topic, retaining only those that show potential to add value to the study.

2.7.3. Eligibility

The eligibility stage involves an in-depth and detailed analysis of the articles previously selected for screening. At this stage, each article undergoes a rigorous, comprehensive content review to assess whether it meets the specific criteria previously defined [16]. These criteria include aspects such as the relevance of the study, methodology, year of publication, language, type of publication, and results. The objective of this stage is to determine the suitability and relevance of each article to answer the research questions posed and its potential contribution to the research.

2.7.4. Inclusion

The inclusion stage corresponds to the final selection of studies that fully meet all established criteria and that will contribute relevant information to the research [16]. Articles that reach this stage are formally considered included in the systematic review.

2.8. Bibliometric analysis

Bibliometric analysis is a complementary quantitative technique used to evaluate and visualize the relationships between selected studies, authors, predominant themes, research trends and collaboration patterns [16]. To perform this analysis, specialized software called VOSviewer is used**.** VOSviewer is a free tool widely recognized and used in the academic and scientific community for its ability to generate clear and detailed graphical representations.

3. RESULTS

The results obtained are presented in this section according to the following sections.

3.1. About the search for studies

Regarding the search for articles in indexed electronic databases, a total of 464 articles were obtained in the Scopus database. This database was selected because it is an information source that houses

many others such as SciELO, ScienceDirect, IEEE, Dialnet, and others. Figure 2 shows the different sources of information and articles found in Scopus.

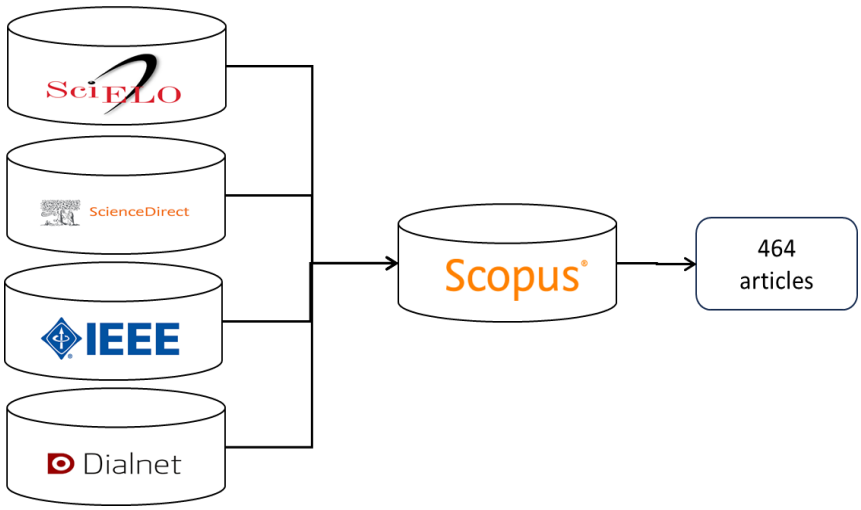

Figure 2. Sources of information and articles found

3.2. On the selection of studies

Of the total of 464 articles found in Scopus and 15 in other sources, the 15 duplicates were eliminated, leaving a total of 464 articles. 362 articles were detected that were unrelated to the search string or that were primarily related to other activities related to the object of study or in another area of application of the technology, leaving a total of 102 articles. Of these, for eligibility reasons, 66 articles were eliminated, finally leaving 36 articles to be considered in the study. This article selection process is shown in Figure 3.

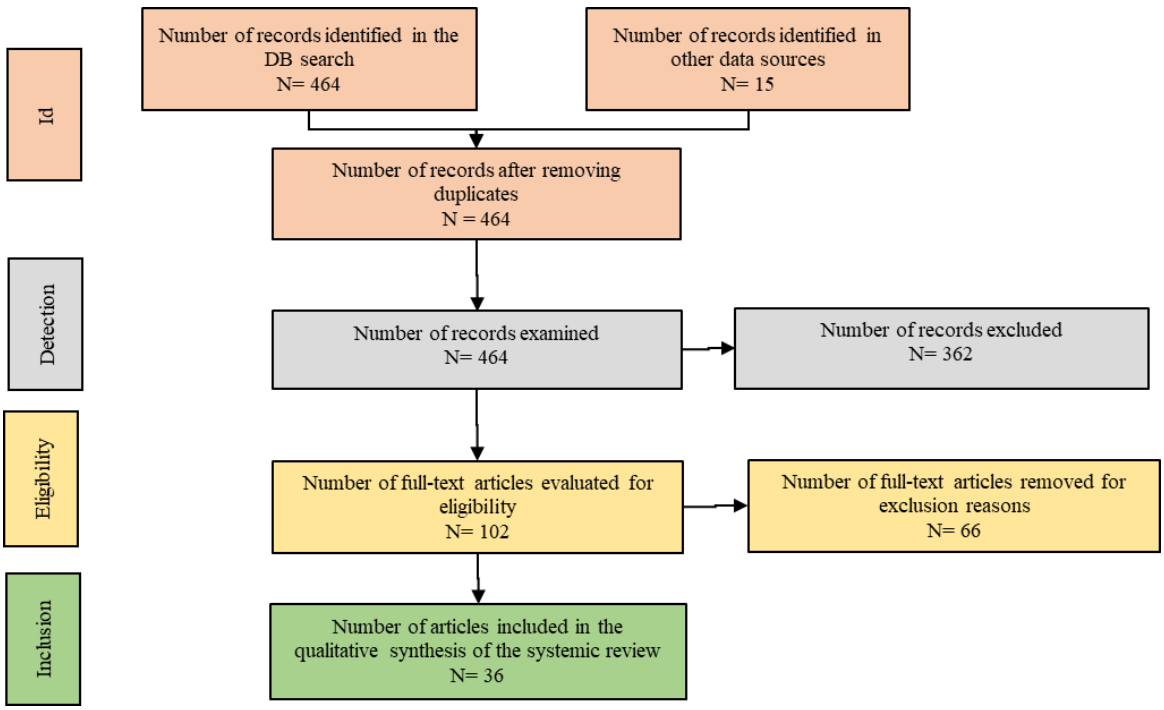

Figure 3. Article selection process

3.3. On the designation of articles

The articles were designated according to their potential contributions; of the 36 articles, 18 contributed to answering question RQ, 15 answered question RQ1, 18 answered question RQ2, and 17 answered question RQ3, as shown in Table 4, which indicates the articles by research question, according to their potential contributions. To better understand the contribution made by each article and to demonstrate the approach taken by each, a summary table has been compiled regarding the considerations of the models and factors analyzed by each article, which contribute to answering research questions RQ and RQ1, as shown in Table 5.

Table 4. Designation of items by question

Questions	Number of Studies	Designation of Studies
RQ	18	[10], [22]–[31], [32]–[38]
RQ1	15	[7], [8], [23], [39]–[48], [49], [50]
RQ2	18	[8], [10], [23], [24], [27]–[29], [31], [32], [34], [40], [41], [43]–[45], [47], [51], [52]
RQ3	17	[23]–[25], [27], [29], [30]–[32], [34], [39], [41]–[43], [45], [51], [52]

Table 5. Analysis of the contribution of the articles to questions RQ and RQ1

	Economy			Organizational				Legal		Socio-Cultural Barriers							Technicians				Security						
Authors	GDP	Spending efficiency	purchasing behavior	Change of habit	Resistance to change	Consumer behavior	Business orientation	Legal Framework	Regulatory Quality	Education	Knowledge	Low cost	Ease of use	Credibility	Perceived usefulness	social influence	Scalability	Interoperability	security	Difficulty of tracking	Data protection	Privacy	Irreversibility	Technical failures	Frauds	Transfer speed	Research questions
[35]			1		1						1	1	1	1	1		1	1	1		1		1			1	
[26]												1	1		1				1							1	
[22]			1		1	1				1	1	1		1	1	1			1								
[36]				1		1	1				1	1	1		1				1								
[28]				1			1	1			1	1			1			1	1	1		1				1	
[24]											1	1	1				1	1	1							1	
[27]		1								1	1		1	1	1	1			1			1					
[33]		1	1		1	1							1		1	1			1		1	1		1	1		
[32]	1	1	1	1		1	1			1					1	1			1			1					
[34]	1	1		1			1	1	1			1			1	1	1	1	1		1	1					RQ
[30]								1	1		1		1		1												
[29]						1	1						1													1	
[10]							1				1		1		1	1	1	1	1								
[31]					1		1	1	1								1		1								
[37]		1						1				1						1	1			1					
[25]										1	1		1	1		1	1	1	1								
[38]		1	1	1	1	1	1	1				1					1	1			1		1			1	
Total	2	6	5	5	5	6	8	6	3	4	9	7	10	4	11	7	7	8	14	1	4	6	2	1	1	6	
[44]		1	1	1		1					1		1	1	1				1		1	1				1	
[23]			1	1	1	1					1		1	1	1	1	1		1	1	1	1		1	1	1	
[42]	1			1	1	1					1		1		1				1		1	1		1	1	1	
[43]	1	1				1	1	1	1									1	1	1	1	1	1	1		1	
[39]				1			1								1		1	1	1				1				
[8]	1			1				1	1	1			1				1	1	1			1			1		
[45]			1		1	1	1			1	1	1	1		1		1	1	1	1	1	1		1		1	
[40]	1	1		1	1		1	1	1	1	1	1	1		1		1	1	1			1				1	RQ1
[41]											1		1		1				1		1	1					
[46]		1																	1	1	1	1	1			1	
[47]							1						1				1	1						1		1	
[7]			1	1				1	1				1						1								
[48]																			1	1	1	1	1				
[49]		1					1						1		1				1			1				1	
[50]																			1			1		1		1	
Total	4	5	4	7	4	5	6	4	4	3	6	2	10	2	8	1	6	6	14	5	8	12	4	6	3	10	

Note: 1, represents that the article refers to the factor or property described in the table

RQ: What are the business models that would facilitate the use of digital money with blockchain technology?

Regarding the business model that facilitates the use of digital money, the analysis of the systematic review shows that the digital money model with blockchain technology must consider the following order of priority of criteria or factors in its design, with "security" being the first priority as a technical factor;

followed by “perceived usefulness,” “ease of use,” “knowledge,” “low cost,” and “social influence” as sociocultural barriers, continuing with “business orientation,” “habit change,” “resistance to change,” and “consumer behavior” as organizational criteria; also considering “purchasing behavior” as the main economic criterion; likewise, “privacy,” “transfer speed,” and “data protection” as the main security criteria.

Considering these criteria, we must conceptualize new ways of conducting transactions and creatively design new financial technologies and special digital currencies [24]. It is also important to keep in mind that the adoption of mobile payment platforms by merchants and businesses will depend largely on technological, organizational, and environmental factors [10]. Likewise, it is necessary to take into account the barriers that affect the full adoption of digital payment methods, such as credibility, usefulness, and social influence, which influence customers' intention to adopt digital payments [23]. It is also necessary to consider the market entry strategy model for the internationalization or massification of products or services [36]. Therefore, it is necessary to evaluate the commercial and organizational conditions under which blockchain technology will be implemented [38], which will contribute to its viability in different contexts.

RQ1: What are the factors that facilitate the use of digital money with blockchain technology?

Regarding the second research question, the analysis of the systematic review shows that the factors that facilitate the use of digital money with blockchain technology are, first and foremost, “security,” “scalability,” and “interoperability” as technical criteria; followed by “privacy,” “data protection,” and “transfer speed” as security criteria; then there are “ease of use,” “perceived usefulness,” and “knowledge” as sociocultural barriers; also considered are “habit change” and “consumer behavior” as organizational criteria; also considered are “purchasing behavior” and “GDP” as economic criteria; and the “legal framework” as legal criteria.

As shown, multiple factors must be taken into account such as technology from short message service (SMS), near field communication (NFC) or quick response code (QR code) [7], without neglecting national development such as: education, regulatory quality, gross domestic product [8], as well as: perceived value, satisfaction, intention of continuous use, are aspects to consider in the adoption of the use of digital technology [39]. Other factors such as operating costs, information asymmetry, transaction speed, and security and transparency are significantly improved with blockchain technology [46], improving operating costs, creating secure transaction records, transaction speed, and the security frameworks provided by blockchain technology [48], as well as security in data transmission [50]. On the other hand, but no less important is the technological adaptation and the acquisition of new knowledge by retailers [25], which will allow the technology to be massified, hand in hand with the preparation of the country's network to adopt the central bank digital currency (CBDC) and digital currencies [40]; being important to consider the delays in transactions due to payment congestion and that these are secure and that they will contribute to massifying transactions [26]; including the gender difference, with men showing greater acceptance than women regarding mobile transactions [41], including the hedonic motivation related to the experience of use, happiness and enjoyment in said transactions [27].

RQ2: What types of currencies facilitate the use of digital money, with blockchain technology?

To analyze the types of digital currencies referred to by the authors, a summary table of the digital currencies referred to by the authors has been prepared, which contribute to answering research questions RQ2, as shown in Table 6. Regarding research question RQ2, the analysis shows that the main digital currencies are Bitcoin and Ethereum, however, there is a great expectation regarding CBDC currencies and fiat digital currencies; however, it is also worth noting that there is a strong preference for stablecoins, because they are more stable digital currencies and, in our opinion, are the digital currencies that will be most accepted in trading centers. This identification of the types of digital currencies must consider the barriers that bank customers perceive regarding the means of exchange, such as privacy, access and impersonalization, which influence the intention to adopt digital payment methods [42], as well as specific social and cultural factors related to the perception of perceived utility and ease of use [30].

Likewise, applications of the lightning network in blockchain technology address the viability of transferring and settling real-world assets [51], as well as the relationship [29] between mobile money, digital banking and the speed of money transfer, are qualities of digital currency, which determines its preference; on this, central banks are also making efforts to apply blockchain technology in central banks [43], being important to address the risks associated with digital money such as; instability, lack of regulation, fraud, irreversibility, difficulty of tracing, lack of materiality, technical failures [52]. It should be noted that the potential for specific uses facilitated by blockchain corresponds to digital cryptocurrencies or digital money, digital assets such as non-fungible tokens (NFTs) and decentralized finance platforms, as supported by Tran *et al.* [47].

Table 6. Analysis of the contribution of the articles to question RQ2

Authors	Bitcoin	Ethereum	Stablecoins	CBDC	Digital fiat currencies	Special digital currencies	Altcoins	Colored coins	Smart contracts	Research questions
[28]	1	1	1	1						
[43]				1						
[23]	1	1			1					
[44]				1	1					
[24]						1				
[10]					1					
[51]	1						1	1	1	
[31]	1	1		1	1					
[52]	1									
[45]	1	1	1	1						RQ2
[40]				1						
[8]	1	1	1	1						
[29]	1	1		1						
[32]					1					
[27]	1	1	1	1						
[34]	1	1	1	1						
[47]	1	1								
[41]	1	1	1	1						
Total	12	10	6	11	5	1	1	1	1	

Note: 1, represents that the article refers to the factor or property described in the table

RQ3: What are the massive commercial centers that facilitate the use of digital money with blockchain technology?

Finally, with regard to mass marketing centers, a summary table has been prepared with the authors' considerations on the characteristics that mass marketing centers must meet to facilitate the use of digital money, and which contribute to answering research question RQ3, as shown in Table 7. In this regard, it should be noted that the literature on the subject does not explicitly identify mass centers. However, the authors agree that there are factors that mass centers must consider in their design and operation to facilitate the use of digital money. These factors include the "technological platform for electronic and digital commerce," "decentralized exchange," and "direct commerce." These design, operation, and functioning criteria for mass centers facilitate the use of digital money.

In line with the results indicated, it is necessary to understand consumer behavior when faced with changes in payment channels when using digital channels [32]. On the other hand, it is necessary to take into account the business orientation of how organizations act in an institutional environment where there are regulations, industry standards, and social expectations [31]. Likewise, the factors that influence the use of electronic money and its impact on spending efficiency and consumer purchasing behavior must be analyzed [44]. This also includes the change in consumer habits that must occur, an aspect that may slow down the adoption of digital currency [34].

Table 7. Analysis of the contribution of the articles to question RQ3

Authors	E-Commerce Platforms - digital	App Stores	Streaming Services	Crowdfunding	Reward structure	Decentralized Exchanges	Direct Trade	Research questions
[23]	1	1	1					
[24]				1	1			
[51]	1					1	1	
[31]	1							
[52]	1							
[25]	1							
[45]	1							RQ3
[29]	1							
[32]	1					1	1	
[27]	1							
[34]	1					1	1	
[30]	1							
Total	11	1	1	1	1	3	3	

Note: 1, represents that the article refers to the factor or property described in the table

3.4. On bibliometric analysis

The bibliometric analysis was performed on the 464 articles found, this analysis used as tools the software VOSviewer, version 1.6.20. and Bibliometrix with R version 4.4.1.

3.4.1. Network visualization

The analysis software presents us with a network visualization in which it shows the most important node groupings by graphing them with colors; the larger the node size, the larger the size of the main node, as shown in Figure 4. The interpretation of the nodes with the respective colors is presented below.

- Red node: It is the main node and has its highest frequency peak in "electronic money," followed by "blockchain" and "cryptoactive" and is also closely related to "mobile payments," "business model," and "finance."
- Celestial node: It has its highest frequency peak in "mobile payments," "mobile commerce" and is closely related to "electronic money" and "finance."
- Green node: It has its highest frequency in two points "finance" and "financial services," these two nodes mentioned are very closely related to each other, and are also related to "electronic money," "blockchain" and "mobile payments."

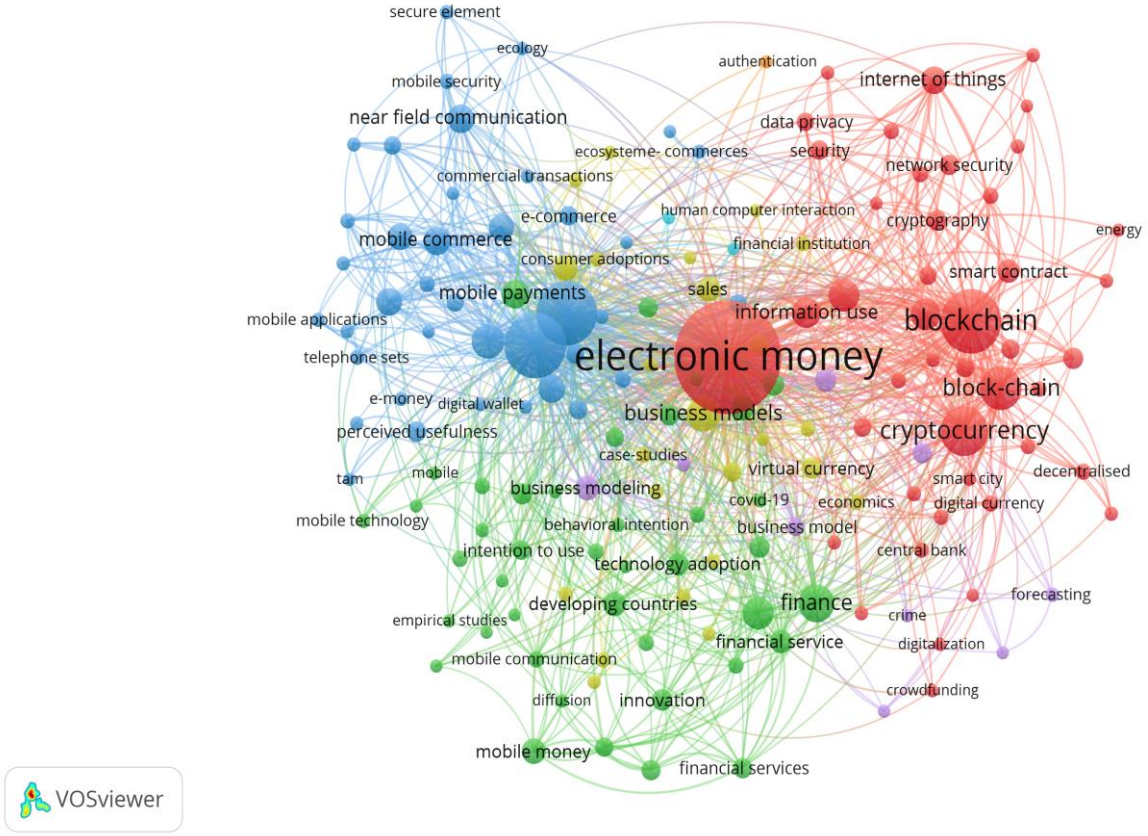

Figure 4. Network visualization

3.4.2. Overlay display

Another analysis presented by the VOSviewer software is the superimposed visualization, as shown in Figure 5. In this figure, the evolution of the terms in recent years can be seen, represented graphically in colors ranging from a dark blue in 2016 to an intense yellow in 2022, passing through dark green and light green. The highest concentration of studies is in the years 2019 and 2020, with the terms "electronic money" and "business model" being predominant in the years of publication. In recent years, the predominant terms are "blockchain," "cryptoassets or cryptocurrency" and linked to the term "finance," in contrast to the previous years 2016 and 2018, where the predominant term is "mobile commerce" and "e- commerce."

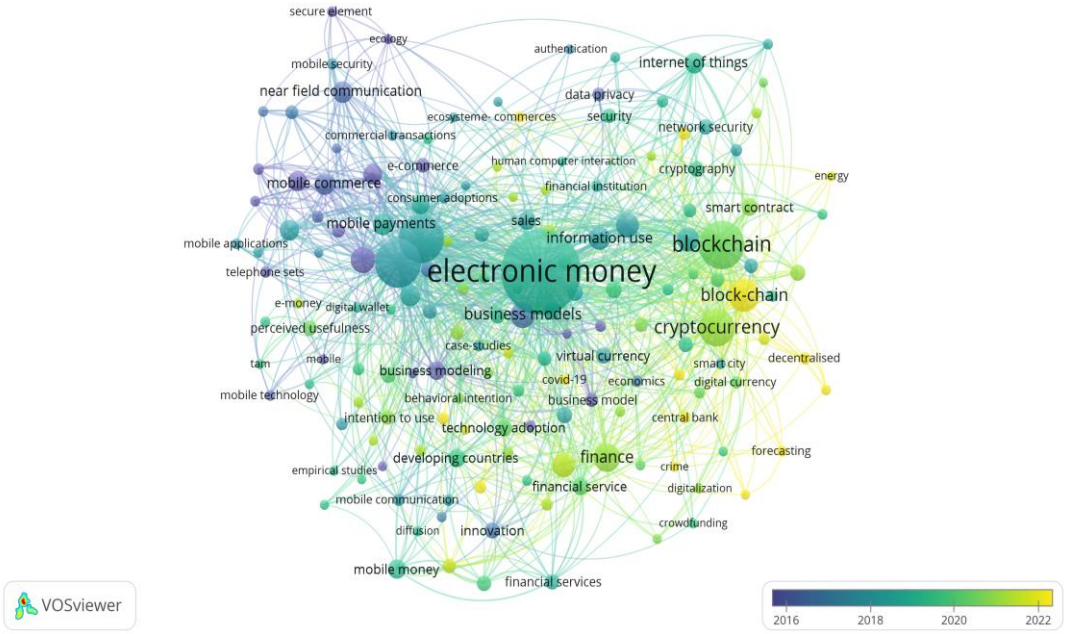

Figure 5. Overlay visualization

3.4.3. World map of country collaboration

The graph of country collaboration was created using the Bibliometrix software, which shows the global collaboration of countries, in relation to the 464 articles identified in the search string, as shown in Figure 6. In this regard, it is noted that the main collaboration is between China and the United States, followed by England and Malaysia, then China and Saudi Arabia, and then China and Hong Kong. It can also be seen that Australia collaborates with China, the United States, and England; in South America, only Brazil, Ecuador, and Chile are present on the map, which shows us that in Peru, this topic has not yet been studied, as shown in the Figure 6.

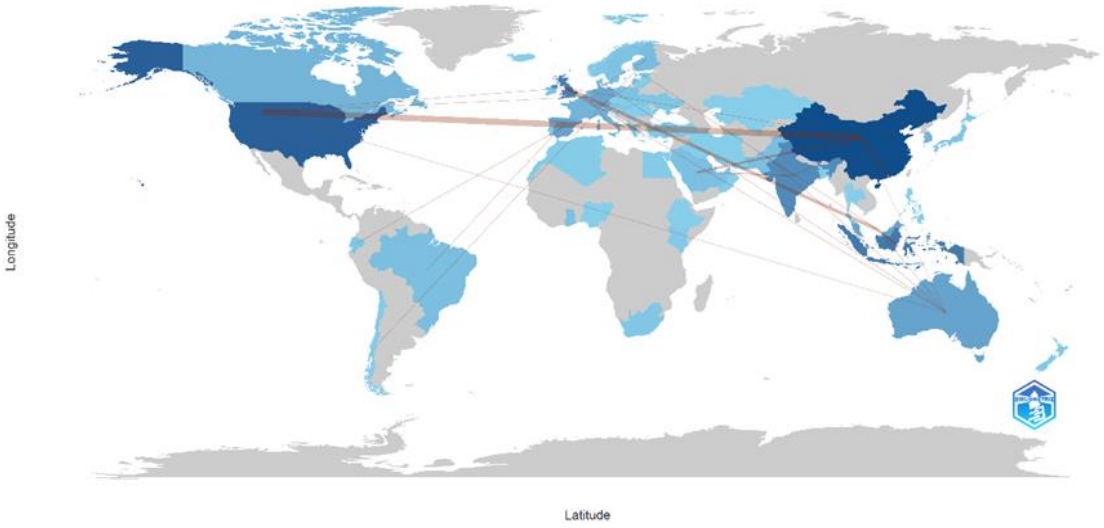

Figure 6. Country collaboration map

3.5. Conceptual model to propose

There is no doubt that the internet has forever changed the business models of industries and companies, in the same way blockchain, since its appearance in 2009, is giving rise to a new economic pattern, a new capitalism based on the decentralization of trust, where all citizens of the world can exchange

goods and services and make payments without the need for third parties (commercial banks) in a reliable and efficient way, constituting an unprecedented advance that will revolutionize the way we finance ourselves, organize the market, and companies [53]. Therefore, we can affirm that the essence of new businesses and access to new markets will depend mainly on the payment network to which one belongs, essentially because technology will allow for simplifying the movement of legal tender money, with very reduced times, and also with private money assets (cryptocurrencies) and financial securities, in a cheap and transparent manner [54]. Therefore, the business model for using digital money with blockchain technology must adapt to all the changing circumstances that lie ahead in the coming years, in which society as a whole will continue to use physical money, albeit to a lesser extent, and the use of digital money and even blockchain will increase. In this sense, Figure 7 presents the proposed conceptual model that corresponds to the ecosystem where the use of digital money interacts, which focuses on electronic money, CBDC and digital money. The proposed business model includes all the recommendations made by the various authors of the documentary review, and therefore, the model has the following components.

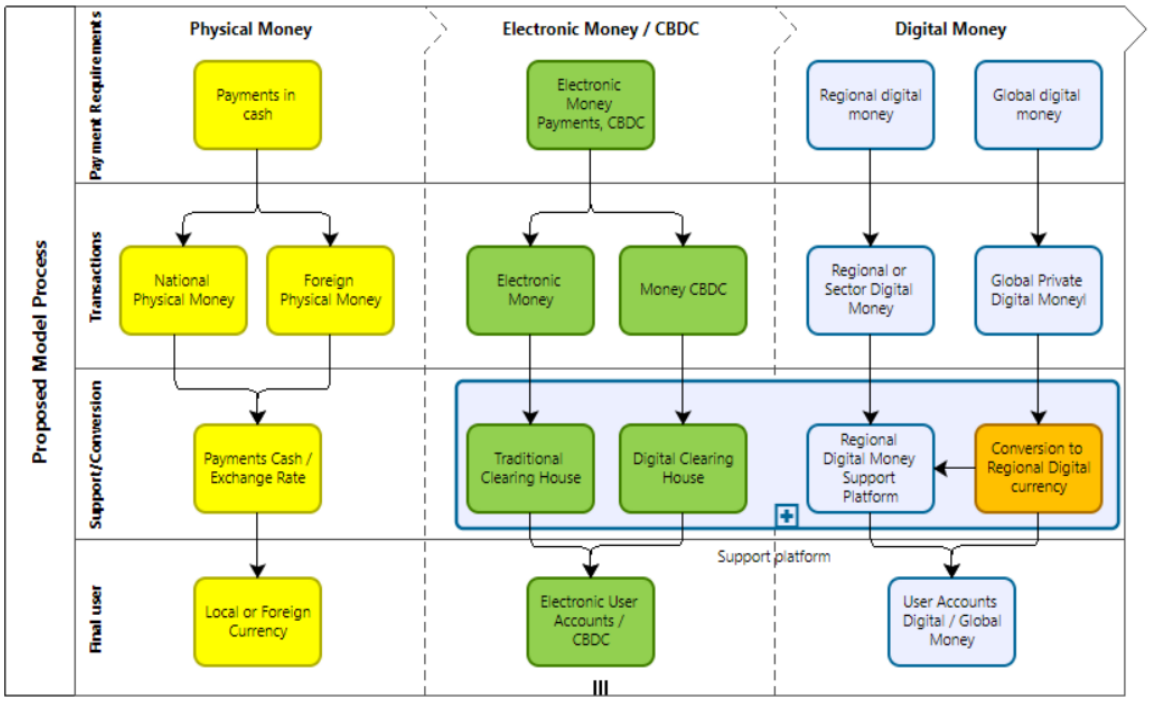

Figure 7. Conceptual model for the use of digital money

3.5.1. Paying user

They are the users who demand a good or service and at the same time are holders of resources in their various forms. These users can be: Users of cash payment, electronic money or digital money from the central bank, regional digital money (specific to the sector), global digital money (such as Bitcoin, Ethereum).

3.5.2. Types of currency

These are the different types of currency that can interact in the business model, from traditional currencies to the currencies that must be issued within the regional scope to which the company belongs, these currencies can be: Local physical money (soles), foreign physical money (dollars, euros), electronic money (fiduciary, registered in active or passive accounts, which can be soles or dollars), central bank digital money (issued by the BCR, which is under analysis), regional digital money (issued privately within a scope or sector and stable, to avoid capital flight with global digital money and avoid speculation) and global digital money (Bitcoin, Ethereum and others).

3.5.3. Clearing house

It is the clearing house that operates within the financial system, both the traditional one and the one that would be implemented in the central bank's digital currency.

3.5.4. Support platform

It is the main part of the proposed model. This platform should be the main tool for recording the blockchain of the regional or sector digital currency. This platform has a particularity and includes a conversion process (for users who pay with global digital currency) to regional digital currency, thus avoiding the leakage of money abroad and reducing the risk of speculation.

3.5.5. End users

These are the companies or individuals who sold the goods or provided the service and now have the money from the service provided. These users ultimately have the money in their accounts, which may be physical money accounts, electronic money accounts, or regional or sector digital money accounts.

4. DISCUSSION

Technological changes have always been a tool that promotes the transformation of commercial transactions. Especially the internet has changed the way in which society as a whole develops commercially. Now blockchain technology [55] poses a technological challenge for the state to adopt the appropriate technology and regulation [56].

Regarding the factors that facilitate the use of digital money, we must take into account the technology and the technological platform [7], without neglecting the characteristics of the population such as education, the human development index, democracy, regulatory quality, and gross domestic product; as argued by [8]. Even the perceived value, satisfaction, and intention to continue using them, as factors that facilitate the adoption of digital technology, as argued by [39]. On the other hand, regarding the regulation of private digital currencies, there is a challenge for the state to regulate their issuance and use, to discourage speculation and illegal use [56] and provide greater security [57] to majority investors and use by minority investors. This regulation must adapt to the ecosystem that society as a whole is developing and adopting as a result of technological changes. Although there are pending challenges regarding digital money, it is also true that a large part of society is already largely using digital money, so the digital money model with blockchain technology that companies will adopt must include digital money coexisting with electronic money and physical money, which gradually the same society will direct its preference towards digital money with blockchain technology, depending on how it experiences and perceives the benefits and especially the ease of use, as well as the associated cost savings that transactions with digital money represent [58], [59].

5. CONCLUSION

The introduction of new technologies has revolutionized the means of exchanging goods and services, fostering the coexistence of different forms of currency, such as physical, electronic, and digital money, the latter being notable for its incorporation of blockchain technology. This technology, complemented by advanced mobile and digital platforms, facilitates efficient and secure transactions. This systematic review clearly answers the questions posed in the research and demonstrates that an effective model for the mass use of blockchain-based digital money must integrate several specific criteria. First, technical criteria stand out, particularly the factors of “security,” “scalability,” and “interoperability.” Second, sociocultural barriers are fundamental, prioritizing factors such as “perceived usefulness,” “ease of use,” and user awareness, given that technological adoption significantly depends on the target audience's level of familiarity. Other key elements in this dimension are “education,” “low cost,” “credibility,” and “social influence.”

Likewise, the model must consider fundamental legal criteria, such as an adequate legal framework and regulatory quality. At the organizational level, it is crucial to manage factors such as habit change, resistance to change, consumer behavior, and entrepreneurial orientation. From an economic perspective, aspects such as GDP, spending efficiency, and purchasing behavior must be evaluated. Notably, the security dimension requires special emphasis on critical factors such as privacy, data protection, difficulty of tracing, irreversibility, technical failures, fraud, and transaction speed.

Regarding digital monetary modalities, the model should incorporate, in addition to traditional electronic money, central bank-issued digital currencies (CBDC) and widely known cryptoassets such as Bitcoin, Ethereum, and stablecoins, the latter preferably referenced to stablecoins and more widely accepted in the target market. Likewise, mass-market centers seeking to adopt digital money with blockchain technology must consider factors such as the “technological platform for electronic and digital commerce,” “decentralized exchange,” and “direct commerce.” These factors significantly facilitate the integration and widespread use of digital money in mass environments.

Blockchain technology enables the enhancement, expansion, streamlining, and reduction of costs associated with commercial transactions, particularly through the implementation of stablecoins and regional digital currencies, which minimize speculative risks inherent in global cryptocurrencies such as Bitcoin and

Ethereum. This strategy provides greater confidence and security for both users and investors within a more robust regulatory framework.

In conclusion, digital money offers many benefits, granting greater security, confidence, speed, and reduced costs for investors. However, inclusive regulation that adapts to current technological, cultural, and legal changes remains a significant challenge for future research and public policy. An additional implication derived from this study is the design and implementation of integrative business models that allow for the interaction of the entire electronic and digital money ecosystem in all social spheres and in all types of commercial transactions.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

The data supporting the findings of this study will be freely available on Google Drive *https://docs.google.com/spreadsheets/d/1FOyi51O91_IQsklMu46FbuCsiXTdlj3J/edit?usp=sharing&ouid=110089325038991328900&rtpof=true&sd=true*, to allow for the contrast and validation of the research findings.

REFERENCES

[1] P. Kaczmarek, "Central bank digital currency: scenarios of implementation and potential consequences for monetary system," *Journal of Central Banking Theory and Practice*, vol. 11, no. 3, pp. 137–154, 2022, doi: 10.2478/jcbtp-2022-0027.

[2] T. Pelagidis and E. Kostika, "Investigating the role of central banks in the interconnection between financial markets and cryptoassets," *Journal of Industrial and Business Economics*, vol. 49, no. 3, pp. 481–507, 2022, doi: 10.1007/s40812-022-00227-z.

[3] G. L. Gómez and M. Demmler, "Social currencies and cryptocurrencies: Characteristics, risks and comparative analysis," *CIRIEC-Espana Revista de Economia Publica, Social y Cooperativa*, no. 93, pp. 265–291, 2018, doi: 10.7203/CIRIEC-E.93.10978.

[4] S. Myeong and Y. Jung, "Administrative reforms in the fourth industrial revolution: The case of blockchain use," *Sustainability (Switzerland)*, vol. 11, no. 14, 2019, doi: 10.3390/su11143971.

[5] P. A. D. S. N. Wijesekara, "A review on deploying blockchain technology for network mobility management," *International Transactions on Electrical Engineering and Computer Science*, vol. 3, no. 1, pp. 1–33, 2024, doi: 10.62760/iteecs.3.1.2024.83.

[6] P. A. D. S. N. Wijesekara, "A literature review on access control in networking employing blockchain," *The Indonesian Journal of Computer Science*, vol. 13, no. 1, pp. 2024–2734, 2024, doi: 10.33022/ijcs.v13i1.3764.

[7] I. R. de Luna, F. Liébana-Cabanillas, J. Sánchez-Fernández, and F. Muñoz-Leiva, "Mobile payment is not all the same: The adoption of mobile payment systems depending on the technology applied," *Technological Forecasting and Social Change*, vol. 146, pp. 931–944, 2019, doi: 10.1016/j.techfore.2018.09.018.

[8] A. Bhimani, K. Hausken, and S. Arif, "Do national development factors affect cryptocurrency adoption?," *Technological Forecasting and Social Change*, vol. 181, 2022, doi: 10.1016/j.techfore.2022.121739.
[9] S. Kunhibava, A. Muneeza, Z. Mustapha, M. Khalid, and G. Kiran, "Blockchain use case in islamic social finance," *ISRA International Journal of Islamic Finance*, vol. 16, no. 1, pp. 93–110, 2024, doi: 10.55188/ijif.v16i1.659.
[10] A. O. Ojo, O. Fawehinmi, C. N. L. Tan, and O. T. Ojo, "Merchant adoption intention of mobile payment platforms in Malaysia," *Journal of Systems and Information Technology*, vol. 26, no. 1, pp. 31–50, 2024, doi: 10.1108/JSIT-08-2022-0200.
[11] D. Kurnia, N. Hidayah, and H. Siringoringo, "A systematic literature review of electronic money research," *International Journal of Electronic Commerce Studies*, vol. 15, no. 3, pp. 1–28, 2024, doi: 10.7903/ijecs.2299.
[12] A. R. Sai and H. Vranken, "Promoting rigor in blockchain energy and environmental footprint research: A systematic literature review," *Blockchain: Research and Applications*, vol. 5, no. 1, 2024, doi: 10.1016/j.bcra.2023.100169.
[13] G. Ali, M. M. Mijwil, B. A. Buruga, and M. Abotaleb, "A comprehensive review on cybersecurity issues and their mitigation measures in FinTech," *Iraqi Journal for Computer Science and Mathematics*, vol. 5, no. 3, pp. 45–91, 2024, doi: 10.52866/ijcsm.2024.05.03.004.
[14] M. Bellucci, D. Cesa Bianchi, and G. Manetti, "Blockchain in accounting practice and research: systematic literature review," *Meditari Accountancy Research*, vol. 30, no. 7, pp. 121–146, 2022, doi: 10.1108/MEDAR-10-2021-1477.
[15] P. Onumadu and H. Abroshan, "Near-field communication (NFC) cyber threats and mitigation solutions in payment transactions: a review," *Sensors*, vol. 24, no. 23, 2024, doi: 10.3390/s24237423.
[16] J. R. N. Villar and M. A. C. Lengua, "A systematic review of the literature on the use of artificial intelligence in forecasting the demand for products and services in various sectors," *International Journal of Advanced Computer Science and Applications*, vol. 15, no. 3, pp. 144–156, 2024, doi: 10.14569/IJACSA.2024.0150315.
[17] P. A. Yagi *et al.*, "A systematic literature review on quadratic programming," in *Proceedings of Seventh International Congress on Information and Communication Technology*, 2023, doi: 10.1007/978-981-19-2397-5_66.
[18] A. L. V. Ubaldo, V. Y. G. Barreto, J. A. B. Albines, L. Andrade-Arenas, and R. S. Bellido-García, "Information security in the banking sector: a systematic literature review on current trends, issues, and challenges," *International Journal of Safety and Security Engineering*, vol. 13, no. 1, pp. 97–106, 2023, doi: 10.18280/ijsse.130111.
[19] M. J. Page *et al.*, "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *PLoS Medicine*, vol. 18, no. 3, Mar. 2021, doi: 10.1371/JOURNAL.PMED.1003583.
[20] A. Khaldi, R. Bouzidi, and F. Nader, "Gamification of e-learning in higher education: a systematic literature review," *Smart Learning Environments*, vol. 10, no. 1, 2023, doi: 10.1186/s40561-023-00227-z.
[21] H. M. C. V. Sebastião, P. J. O. R. da Cunha, and P. M. C. Godinho, "Cryptocurrencies and blockchain. Overview and future perspectives," *International Journal of Economics and Business Research*, vol. 21, no. 3, pp. 305–342, 2021, doi: 10.1504/ijebr.2021.114400.
[22] H. Hilale and A. Chakor, "Acceptance of electronic payment systems: A critical review forward a parsimonious model including vertical and horizontal cultural orientations," *Telematics and Informatics Reports*, vol. 14, 2024, doi: 10.1016/j.teler.2024.100139.
[23] I. Dimitrova, "Barrier-breakers' influence on full-adoption of digital payment methods," *Internet Research*, vol. 34, no. 7, pp. 139–159, 2024, doi: 10.1108/INTR-11-2022-0886.
[24] C. Elsden, E. Morgan, and C. Speed, "Creative transactions: Special digital monies in break kickstarter' crowdfunding campaigns," 2021, doi: 10.1145/3411764.3445632.
[25] M. Jocevski, A. Ghezzi, and N. Arvidsson, "Exploring the growth challenge of mobile payment platforms: A business model perspective," *Electronic Commerce Research and Applications*, vol. 40, 2020, doi: 10.1016/j.elerap.2019.100908.
[26] H. Shen, B. Shen, and Y. E. Penghao, "A switch on electronic commerce mobile payment: From traditional queuing to elastic request as a payment service based on the edge computing model," in *Proceedings of the International Conference on Electronic Business (ICEB)*, 2019, vol. 2019-December, pp. 13–26.
[27] Z. Ali and H. Bano, "Understanding consumer intention towards blockchain-based mobile payment adoption services in Pakistan," *International Journal of e-Collaboration*, vol. 18, no. 3, 2022, doi: 10.4018/IJeC.307136.
[28] S. Ahluwalia, R. V. Mahto, and M. Guerrero, "Blockchain technology and startup financing: A transaction cost economics perspective," *Technological Forecasting and Social Change*, vol. 151, 2020, doi: 10.1016/j.techfore.2019.119854.
[29] E. N. N. D. Ocansey, P. Dadzie, and N. B. Nambie, "Mobile money use, digital banking services and velocity of money in Ghana," *International Journal of Economics and Financial Issues*, vol. 14, no. 2, pp. 218–233, 2024, doi: 10.32479/ijefi.15767.
[30] H. M. Aji, I. Berakon, and A. F. Riza, "The effects of subjective norm and knowledge about riba on intention to use e-money in Indonesia," *Journal of Islamic Marketing*, vol. 12, no. 6, pp. 1180–1196, 2021, doi: 10.1108/JIMA-10-2019-0203.
[31] B. Cowden and J. Tang, "Institutional entrepreneurial orientation: Beyond setting the rules of the game for blockchain technology," *Technological Forecasting and Social Change*, vol. 180, 2022, doi: 10.1016/j.techfore.2022.121734.
[32] R. Yusfiarto, S. Sunarsih, and D. Darmawan, "Understanding Muslim's switching from cash to m-payments: based on push-pull-mooring framework," *Journal of Islamic Marketing*, vol. 14, no. 2, pp. 342–365, 2023, doi: 10.1108/JIMA-05-2021-0135.
[33] A. A. Akanferi, I. Asampana, A. H. Matey, and H. A. Tanye, "Adoption of mobile commerce and mobile payments in Ghana: An examination of factors influencing public servants," *Interdisciplinary Journal of Information, Knowledge, and Management*, vol. 17, pp. 287–313, 2022, doi: 10.28945/4981.
[34] C. Yingyun, "The impact of China's central bank digital currency on domestic commercial banks," *Frontiers in Artificial Intelligence and Applications*, vol. 367, pp. 208–220, 2023, doi: 10.3233/FAIA230021.
[35] X. Li, X. Zhu, Y. Lu, D. Shi, and W. Deng, "Understanding the continuous usage of mobile payment integrated into social media platform: The case of WeChat Pay," *Electronic Commerce Research and Applications*, vol. 60, 2023, doi: 10.1016/j.elerap.2023.101275.
[36] B. C. Chew, X. Shen, and J. Ansell, "Alipay entered Malaysia: a closer look at the new market entry strategy driven by Chinese tourists," *Qualitative Research in Financial Markets*, vol. 12, no. 4, pp. 561–577, 2020, doi: 10.1108/QRFM-06-2019-0069.
[37] I. R. Abdelhamid, I. T. A. Halim, A. El-Majeed Amin Ali, and I. A. Ibrahim, "A survey on blockchain for intelligent governmental applications," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 31, no. 1, pp. 501–513, 2023, doi: 10.11591/ijeecs.v31.i1.pp501-513.
[38] T. Almeshal, J. Berri, T. Almulhim, A. Alhogail, and E. Ahmed, "Business blockchain suitability determinants: decision-making through an intuitionistic fuzzy method," *Computer Systems Science and Engineering*, vol. 47, no. 2, pp. 1665–1690, 2023, doi: 10.32604/csse.2023.038871.
[39] H. Choi, J. Park, J. Kim, and Y. Jung, "Consumer preferences of attributes of mobile payment services in South Korea," *Telematics and Informatics*, vol. 51, 2020, doi: 10.1016/j.tele.2020.101397.
[40] M. A. Mohammed, C. De-Pablos-Heredero, and J. L. Montes Botella, "Exploring the factors affecting countries' adoption of blockchain-enabled central bank digital currencies," *Future Internet*, vol. 15, no. 10, 2023, doi: 10.3390/fi15100321.

[41] R. Alabdan and M. M. Sulphey, "Understanding proximity mobile payment acceptance among Saudi individuals: An exploratory study," *International Journal of Advanced Computer Science and Applications*, vol. 11, no. 4, pp. 264–270, 2020, doi: 10.14569/ijacsa.2020.0110436.
[42] I. Dimitrova, P. Öhman, and D. Yazdanfar, "Barriers to bank customers' intention to fully adopt digital payment methods," *International Journal of Quality and Service Sciences*, vol. 14, no. 5, pp. 16–36, 2022, doi: 10.1108/IJQSS-03-2021-0045.
[43] N. Dashkevich, S. Counsell, and G. Destefanis, "Blockchain application for central banks: a systematic mapping study," *IEEE Access*, vol. 8, pp. 139918–139952, 2020, doi: 10.1109/ACCESS.2020.3012295.
[44] P. Lumbanraja, A. N. Lubis, B. K. Hasibuan, and H. Harahap, "Analysis of factors affecting usage electronic money on shopping behavior on metropolitan consumers in Indonesia moderated by shopping efficiency," *Quality - Access to Success*, vol. 25, no. 199, pp. 183–192, 2024, doi: 10.47750/QAS/25.199.20.
[45] S. Moghavvemi, T. X. Mei, S. W. Phoong, and S. Y. Phoong, "Drivers and barriers of mobile payment adoption: Malaysian merchants' perspective," *Journal of Retailing and Consumer Services*, vol. 59, 2021, doi: 10.1016/j.jretconser.2020.102364.
[46] C. H. Hoffmann, "Blockchain use cases revisited: Micro-lending solutions for retail banking and financial inclusion," *Journal of Systems Science and Information*, vol. 9, no. 1, pp. 1–15, 2021, doi: 10.21078/JSSI-2021-001-15.
[47] N. K. Tran, M. A. Babar, and A. Walters, "A framework for automating deployment and evaluation of blockchain networks," *Journal of Network and Computer Applications*, vol. 206, 2022, doi: 10.1016/j.jnca.2022.103460.
[48] M. Al Ketbi, K. Shuaib, E. Barka, and M. Gergely, "Establishing a security control framework for blockchain technology," *Interdisciplinary Journal of Information, Knowledge, and Management*, vol. 16, pp. 307–330, 2021, doi: 10.28945/4837.
[49] H. S. Ali, F. Jia, Z. Lou, and J. Xie, "Effect of blockchain technology initiatives on firms' market value," *Financial Innovation*, vol. 9, no. 1, 2023, doi: 10.1186/s40854-023-00456-8.
[50] R. K. Dhanaraj, S. Kadry, B. G. Kang, and Y. Nam, "Probit cryptographic blockchain for secure data transmission in intelligent transportation systems," *Journal of Internet Technology*, vol. 23, no. 6, pp. 1303–1313, 2022, doi: 10.53106/160792642022112306013.
[51] M. H. Miraz and D. C. Donald, "Lapps: Technological, legal and market potentials of blockchain lightning network applications," in *ACM International Conference Proceeding Series*, 2019, pp. 185–189, doi: 10.1145/3325917.3325942.
[52] P. Esmaeilzadeh and others, "Individuals' cryptocurrency adoption: A proposed moderated mediation model," in *25th Americas Conference on Information Systems, AMCIS 2019*, 2019, pp. 1–10.
[53] M. del C. P. Sempere, "Cryptocurrencies: would a legal disruption in the Eurozone?," *Revista de Estudios Europeos*, no. 70, pp. 284–318, 2017.
[54] C. P. Sempere, "The digitalization of money and payments in the post-Covid digital market economy," *Ekonomiaz*, pp. 296–321, 2020.
[55] D. Andolfatto and F. M. Martin, "The blockchain revolution: decoding digital currencies," *Federal Reserve Bank of St. Louis Review*, vol. 104, no. 3, pp. 149–165, 2022, doi: 10.20955/r.104.149-65.
[56] M. Díaz and others, "Blockchain for securing digital evidence in forensic environments readiness," *Sedici.Unlp.Edu.Ar*, no. 1, 2020.
[57] M. M. Islam and H. P. In, "A privacy-preserving transparent central bank digital currency system based on blockchain and unspent consortium transaction outputs," *IEEE Transactions on Services Computing*, vol. 16, no. 4, pp. 2372–2386, 2023, doi: 10.1109/TSC.2022.3226120.
[58] A. Belke and E. Beretta, "From cash to central bank digital currencies and cryptocurrencies: a balancing act between modernity and monetary stability," *Journal of Economic Studies*, vol. 47, no. 4, pp. 911–938, 2020, doi: 10.1108/JES-07-2019-0311.
[59] A. Milne, "Argument by false analogy: the mistaken classification of bitcoin as token Money," *Journal of Money, Credit and Banking*, vol. 56, no. 8, pp. 2199–2222, 2024, doi: 10.1111/jmcb.13061.

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