ACADEMO
Revista de Investigación en Ciencias Sociales y Humanidades
ISSN 2414-8938. Vol. 12 Nro. 3, 2025.

ORIGINAL ARTICLE

https://doi.org/10.30545/academo.2025.n3.1206

Digital transformation of Latin America Pymes: scienciometric study

Transformación digital de Pymes en Latinoamérica: estudio cienciométrico

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Abstract

Digital Transformation in SMEs has allowed them to expand their reach to new customers and improve their effectiveness and decision-making. This study aimed to analyze the scientific production on Digital Transformation of SMEs in Latin America. A bibliometric study was performed. The source of consultation was the Web of Science (WoS) (covering a decade 2013-2023). The analysis covered general production metrics and intellectual and conceptual structures. The results showed a growing interest in this topic. Scientific publications have evolved favorably; however, some gaps need to be addressed for more development of SMEs in the region. Those gaps include digital transformation in financial processes and from the perspective of sustainability. It is necessary to increase international collaboration in research and development. Authors conclude the need for more research to fill in the gaps and to incorporate some Latin American countries that do not report Digital Transformation production in SMEs.

Keywords: *SMEs, digital transformation, innovation, digitalization, industry 4.0.*

Resumen

La Transformación Digital en las Pymes ha permitido ampliar su alcance a nuevos clientes y mejorar su efectividad y toma de decisiones. El objetivo de este estudio es analizar la producción científica sobre Trasformación Digital de Pymes en Latinoamérica. Se ejecutó un estudio bibliométrico, tomando como fuente de consulta la Web of Science (WoS) (cubriendo el periodo de 2013 a 2023). El análisis abarcó las métricas generales de producción, la estructura intelectual y la conceptual. Los resultados mostraron interés creciente por esta temática. Aunque la publicación científica ha evolucionado favorablemente, hay brechas que deben abordarse para un mayor desarrollo de las Pymes en la región. Entre estas se encuentran la transformación digital en los procesos financieros y desde la mirada de la sostenibilidad. Es necesario incrementar la colaboración internacional en investigación y desarrollo. Se concluye la necesidad de seguir investigando en las brechas identificadas e incorporar algunos países latinoamericanos que no reportan producción sobre Trasformación Digital en Pymes.

Palabras clave: *Pymes, transformación digital, innovación, digitalización, industria 4.0.*

Correspondence: Bexi Perdomo (bperdomo@ucal.edu.pe)
Article received: December 13, 2024. Accepted for publication: December 5, 2025. Published: December 12, 2025.
Conflicts of interest: None.
Funding source: None.
Responsible Editor: Herib Caballero Campos. Universidad Americana. Asunción, Paraguay.

Website: http://revistacientifica.uamericana.edu.py/index.php/academo/

Introduction

The continuous process of innovation has become a strategic option for most companies, as it improves operational efficiency, reduces costs, and increases success in the field of innovation. Within this context lies digital transformation (DT), defined by Delgado (2020) as an evolutionary process, continuous over time or a radical change, whether in technological changes or through the digitization of processes. Ren et al. (2022) define it as a process that emerges from the adoption of numerous modern technologies such as those aimed at data collection, storage and analysis, artificial intelligence, robotics, automation, the Internet of Things, cloud computing, and digital platforms. In contrast, Kaganer et al. (2023) define DT as changes in processes driven by the implementation of technologies or changes in business models and digital pathways for value creation in a product or service.

There are terms that can be mistakenly used interchangeably but are not identical, and therefore must be clarified. These include *digitization*, *digitalization*, and *digital transformation* (Hinings et al., 2018; Mohammadi et al., 2023). As noted by Børsen & Contreras (2022), the difficulty in distinguishing these terms is greater in Spanish because, when translated, the first two become one ("digitalización"), even though there are differences between them. In this sense, it is prudent to present them using their original terms. Thus, *digitization* refers to converting analog information into encoded digital information, which has been happening since the widespread adoption of computers. *Digitalization*, in turn, represents the stage in which a company must first identify processes that can be automated. Finally, DT involves a radical process of change carried out through digitalization and the incorporation of digital technologies and innovations in the various processes of a company (Delgado, 2020; Hinings et al., 2018; Kaganer et al., 2023).

Companies that incorporate sustainable approaches and orient themselves toward DT obtain their own benefits and contribute to a positive transformation in society (Plečko & Bradač, 2024). DT is changing the business landscape, and researchers have provided guidelines on models and frameworks that may work across different businesses for its incorporation, effective use of resources, and greater gains (Aghamiri et al., 2022). DT has permeated different environments, including small and medium-sized enterprises (SMEs), which must adapt to the technological revolution to improve their capabilities, develop agile responses, and make intelligent decisions. In doing so, they may increase their development by up to 50% after implementing DT, as seen in SMEs in countries such as China (Teng et al., 2022).

In Latin America, SMEs play a fundamental role in generating employment and fostering economic inclusion. They represent an important segment of businesses in commerce, manufacturing, and services, contributing significantly to the Gross Domestic Product (GDP) of countries in the region (Ortiz-Choez et al., 2024). In this context, the concept of SMEs varies by country but generally refers to companies with a limited number of employees and revenue volume (Owalla et al., 2022), characterized by flexibility, adaptability, and contributions to employment and economic development (Holland & Gutiérrez-Leefmans, 2018; Scuotto et al., 2023). These organizations play an important role in their business environments but often face challenges such as lack of access to financing and regulatory and technological barriers that tend to limit their progress (Gutierrez-Leefmans & Holland, 2019; Kumar & Kumar, 2023). Despite facing persistent challenges such as informality and lack of access to credit, Latin American SMEs have demonstrated notable adaptability and resilience. Given their role in local and regional economies, their constant study becomes essential for identifying solutions and proposals that contribute to their growth.

DT in SMEs has grown in recent years, allowing them to broaden their reach to new customers and improve their effectiveness in product development and decision-making. As DT development increases in SMEs, these businesses seek to enhance their core competencies and pursue sustainable development, for example, by using digital technologies such as cloud computing, social media, big data, and other

technological tools to inform commercial strategies in decision-making (Hu et al., 2024).

According to Corejova & Chinoracky (2021), digital transformation can be implemented in any country, regardless of the purchasing power of its population or its GDP per capita. Currently, more than 90% of small and medium-sized enterprises in Europe have achieved a basic level of digital implementation, which enables them to offer better products and generate higher revenues (Burinskienė & Nalivaikė, 2024). Regarding the benefits of DT for SMEs, Aghamiri et al. (2022) indicate that DT creates a vital shift in how a company uses technological processes and innovation, as well as data digitalization, for decision-making. Implementing DT tools improves overall operational performance, based on three key resources: digital technology development, employees' digital skills, and digital transformation strategies (Teng et al., 2022). The benefits of adopting DT in SMEs include establishing a successful process that, once replicated, multiplies the likelihood of success in other SMEs (Hassan et al., 2023).

DT in SMEs is associated with their competitiveness and survival. Understanding it can help prevent failures in its implementation (Costa et al., 2023). DT in SMEs in the textile sector has enabled better decision-making and improved product offerings, achieving greater customer satisfaction, increased efficiency, and reduced manual errors (Tsai & Su, 2022). In sports-related businesses, DT is a priority for 80% of companies worldwide, as it creates greater efficiency and productivity, allowing entry into new markets, process automation, innovation, enhanced customer satisfaction, and increased revenues (Mohammadi et al., 2023).

DT in SMEs is present in different countries with various levels of development. Among them are the United States, the European Union, and China, where in recent decades growth has been supported by the implementation of DT, artificial intelligence, robotics, and other technologies for improved operational efficiency (Ren et al., 2022). In China, positive results have been achieved through the development of high-end products, smart practices, and environmentally sustainable approaches (Ren et al., 2022). They leverage technologies such as big data to renew traditional operations and invest in DT across various sectors (Zhou & Xu, 2023). Analyses focused on SMEs in the business environment indicate that processes are becoming increasingly digitized (Hu et al., 2024).

Efforts to understand the phenomenon of DT in SMEs have been published. For example, Marino-Romero et al. (2023) studied the evolution of digital transformation in specific processes such as management in SMEs between 2015 and 2022. Others have focused on analyzing literature on aspects related to DT, such as the digitalization of certain processes and the integration of digitalization from a global bibliometric perspective (Kumar & Kumar, 2023; Re et al., 2023).

In the Latin American context, reviews have been published that reflect researchers' interest and the abundance of literature. For instance, Plečko & Bradač (2024) found that, compared with European and North American countries, Latin American countries show greater awareness of the importance of DT for achieving higher levels of sustainability in entrepreneurship. Miñan et al. (2023) conducted a literature review with a brief bibliometric overview on DT in Latin America between 2019 and 2023; however, their study addressed digital transformation in general rather than focusing on SMEs. In the domain of Latin American SMEs, Calderón et al. (2023) conducted a systematic literature review to investigate this phenomenon in relation to the internationalization of manufacturing companies, finding that it plays a fundamental role.

Although there have been publications on DT in Latin American SMEs, there is no updated bibliometric review that identifies thematic trends and gaps to continue developing research. This type of study provides academics, researchers, and students with relevant information for consultation and publication on the topic and contributes to the development of the region (Agarwal et al., 2016). In this way, evidence is provided on the development of research directly related to the second target of the eighth Sustainable Development Goal, which calls for increased

productivity levels through strategies of technological modernization and innovation.

In this context, this bibliometric study aimed to analyze the scientific production on DT in SMEs in Latin America. To properly guide the study, three specific objectives were established: (1) to describe general production information, (2) to identify the social structure (information on collaborations among authors, institutions, and countries) of scientific production on DT in SMEs, and (3) to identify the conceptual structure based on the analysis of keywords, thematic trends, and gaps.

Methodology

A bibliometric study was carried out following the five phases recommended by Zupic & Čater (2015): research design, collection of bibliometric data, analysis, visualization, and interpretation. Likewise, the analysis techniques suggested by Donthu et al. (2021) for general metrics, social structure analysis, and conceptual structure analysis were considered.

This research involved a bibliometric review of a collection of articles from the Web of Science (WoS) database. As noted by Pranckutė (2021), this database has crucial attributes that position it as an optimal source for bibliometric studies, allowing searches in common language as well as specialized descriptors.

The search was carried out using English terms, increasing the likelihood of obtaining results. To select the search terms, the UNESCO Thesaurus was reviewed, confirming that it does not contain the terms "digital transformation," "Pyme," or "SME." Next, a review was conducted to identify the keywords used by authors in published articles, selecting the following author keywords: Digital Transformation, Small and Medium-sized Enterprises, and SMEs. The search was performed using these keywords and the logical operators AND and OR, and it was conducted in June 2024. The intention was to cover a previous decade (from 2013 to 2023). To refine the search and select the studies, the criteria detailed in table 1 were used.

Table 1. Criterios para la selección de los estudios.

Criteria	Description
Access	Open access
Countries	Latin American
Indexes	SCI Expanded, SSCI, ESCI, and CPCI-SSH
Areas of knowledge	Management, Business, Economics, Social Sciences, Business Finance
Content	On digital transformation in Latin American SMEs

The search syntax was: “Digital Transformation” (Topic) AND “Small and medium-sized enterprises” OR “SME” (Topic) AND Chile OR Colombia OR Argentina OR Cuba OR Uruguay OR Brazil OR Ecuador OR Peru OR Venezuela OR Mexico OR Bolivia OR Honduras OR Costa Rica (Countries/Regions) AND Management OR Business OR Economics OR Social Sciences Interdisciplinary OR Business Finance (Web of Science Categories).

The Latin American countries included in the syntax were those with publications indexed in the inclusion criteria, as some had no indexed publications.

The initial search yielded 12,301 documents. Applying the index filter reduced this number to 8,820. Then, the country filter reduced it to 458. Limiting by subject areas (to avoid biases due to confusion with the acronym *SME* in fields such as biochemistry) resulted in 203 documents for analysis.

The data were downloaded in .ris and Bibtex formats. The absence of duplicates was verified using the online tool *Systematic Review Accelerator*, by Bond University. The analyses were conducted using Bibliometrix-Biblioshiny, a software tool with high-quality options for bibliometric and scientometric research (Aria & Cuccurullo, 2017). Data visualization was performed through tables and figures generated by Bibliometrix, ggPlot, VOSviewer, and Excel. The bibliometric techniques selected correspond to the classification of Donthu et al. (2021): general production metrics, network analysis techniques, and scientific mapping.

Results and Discussion

General Metrics

Scientific production on digital transformation in SMEs in WoS registered its first document in 2013. General

information about this production is summarized in table 2.

Table 2. General information on the documents analyzed.

Main information	
Period	2013:2023
Sources	129
Documents	190
Annual growth %	23.49 %
Average document age	4.03
Average citations per document	11.52
Content	
Keywords Plus (ID)	474
Author keywords (DE)	608
Authors	
Authors	518
Authors of single-authored documents	18
Collaboration	
Single-authored document	19
Co-authors per document	3.08
International co-authorship	47.89 %
Types	
Article	161
Book chapter	12
Editorial material	1
Conference proceedings	12
Review	4

Table 2 also shows that the prevailing document type is the research article and that co-authorship is the most common authorship pattern, while single authorship appears at a low proportion (n = 18).

Annual Production

Several stages or trends in production were observed. Between 2013 and 2017, there was an average trend of six articles per year. In 2018, production rose sharply to 13 articles, but differs substantially from the 2019–2023 period, which shows an average of 29 articles annually, stabilizing at 33 in the last two years (Figure 1).

Growing interest in studying the topic was observed across different countries in the region, especially from 2019 onward, similar to what has been noted in other studies on SMEs outside the Latin American context (Felzensztein et al., 2022; Oura et al., 2016).

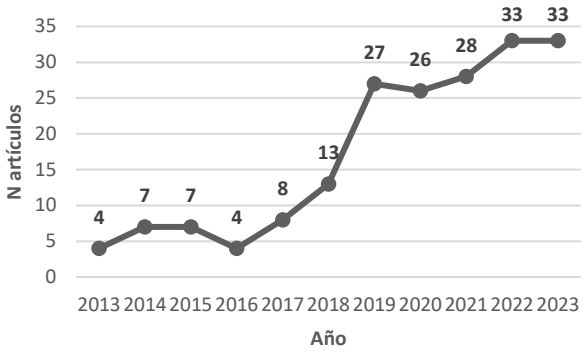

Figure 1. Annual scientific production.

Most Relevant Sources

The most prominent source is the journal Universidad y Sociedad, which experienced notable growth starting in 2020 (Figure 2). The second most productive source at present (Academia – Revista Latinoamericana de Administración) shows sustained and stable growth throughout the study period.

The journals recommended as primary consultation sources for containing the greatest number of publications on digital transformation in Latin American SMEs are *Universidad y Sociedad* and *Academia – Revista Latinoamericana de Administración*. The third recommended source is *Journal of Business Research*, and its prominent position aligns with findings by Marino-Romero et al. (2023), who identified it as the second most published journal on global SME digital transformation.

Most Relevant Authors

In 2018, Cardona, Castillo, Giraldo, and López stood out, although they did not publish after this period. In 2021, García-Pérez-de-Lema, Hervas-Oliver, and Sempere-Ripoll emerged; although their production is lower than the most prominent authors in 2018, they became the most productive (Figure 3).

Most Productive Institutions and Countries

Between 2014 and 2018, the National Autonomous University of Mexico consistently produced five articles per year, increasing to ten articles in 2022. Meanwhile, the Autonomous University of Aguascalientes produced two articles annually between 2015 and 2018, with continuous growth until reaching ten articles in 2022 (Figure 4).

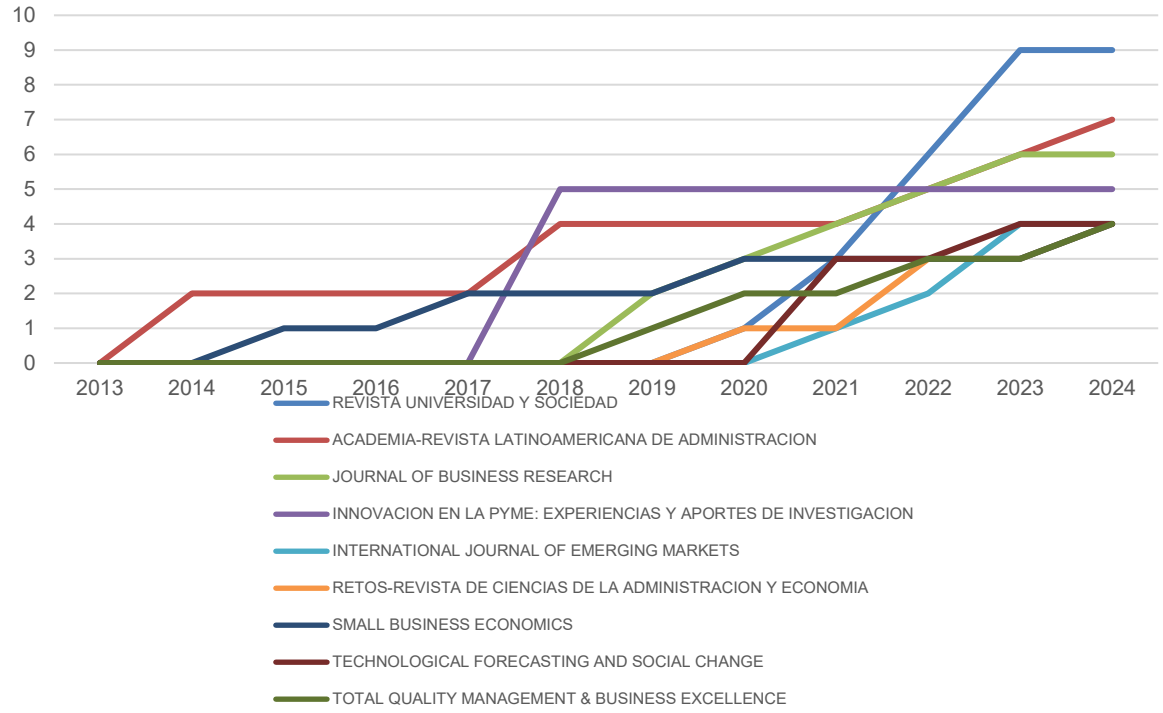

Figure 2. Journal production over time.

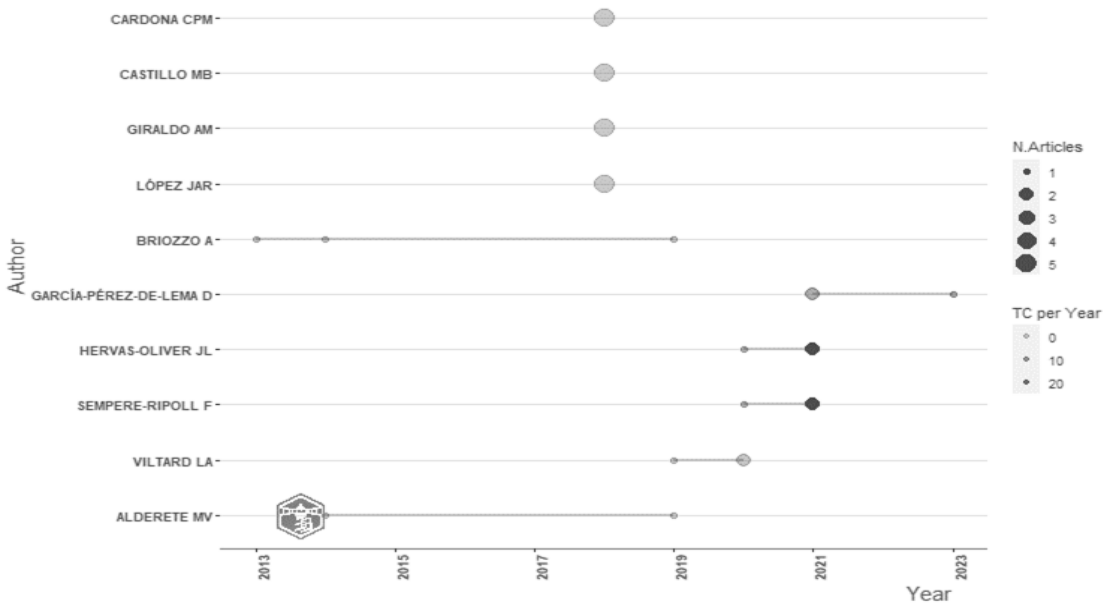

Figure 3. Evolution of the most prolific authors' production.

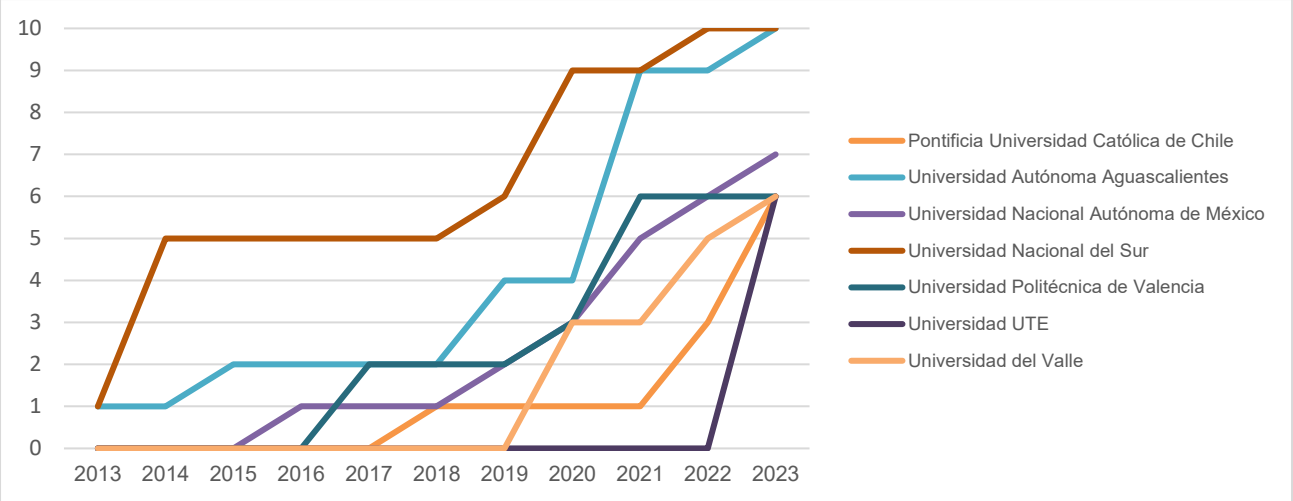

Figure 4. Production of the most prominent institutions.

Figure 5 shows the countries with the highest scientific production on DT. The top two countries are Brazil and Mexico, with 104 and 69 documents respectively. Among the last countries on this list is Peru, with a production of 17 documents.

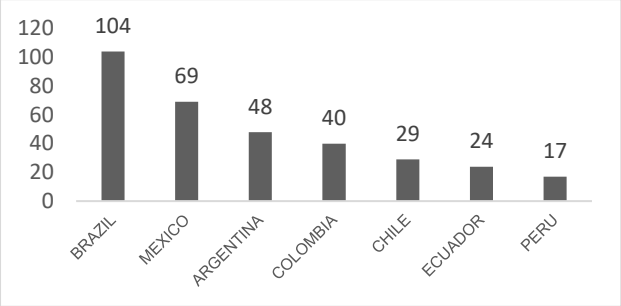

Figure 5. Countries with the highest production of documents.

If the goal is to strengthen international research within Latin America, it is recommended to establish networks with researchers from Mexico and Brazil, as these were the countries with the highest production. This information is valuable when planning research projects aimed at strengthening SMEs, which, as has been demonstrated in the literature, play an undeniably important role in the region (Baltodano & Leyva, 2020).

Social structure

To address the second research question, the collaborative interaction among authors was analyzed. Table 3 shows the composition of each of the clusters formed by the authors. Cluster number seven contains the authors with the highest joint output and the most publications in 2018. The other clusters with strong interaction are six and nine, represented by three and four authors, respectively, which reflect a strong trend of collaborative work.

The collaboration between institutions was analyzed (Table 4). Cluster seven brings together the universities with the highest number of joint publications (National Autonomous University of Mexico, Autonomous University of the State of Mexico, and the National Polytechnic Institute). They showed extensive output in recent years, totaling up to 10 articles between 2022 and 2023.

Table 3. Summary of the clusters of authors based on their collaboration in scientific production.

Clúster	Authors	Clúster	Authors
1	Briozzo A; Cardone-Riportella C	7	Cardona C; Castillo MB Giraldo A; López JAR
2	Gutiérrez-Leefmans M; Holland CP	8	García-Vidal G; Martínez-Vivar R; Pérez-Campdesuñer R
3	De Carvalho RSMC; De Medeiros DD	9	Cortes Mr; Jimenez HF; Londoño CA; Rativa JR
4	Hervas-Oliver JL; Sempere-Ripoll F; Boronat-Moll C	10	Alvarez-Torres F; Lopez-Torres GC
5	Castillo-Vergara M	11	Espinosa-Méndez C; Inostroza MA
6	Johanson M; Oliveira L; Bai WS;Ratajczak-Mrozek M	12	Faccin K; Marconatto DAB

Table 4. Clusters of collaborations among institutions.

Clúster	Institutions
1	Universidad del Valle, Universidad Icesi, Universidad de Valencia.
2	Universidad Politécnica de Valencia, Universidad de la Costa.
3	Universidad del Pacifico, Pontificia Universidad Católica de Argentina.
4	Center for International Business Studies, Dalarna University.
5	Universidad Nacional del Sur, Buenos Aires.
6	Universidade Federal Rio Grande do Sul, Universidade Grenoble Alpes. Universidad Nacional Autónoma de México.
7	Universidad Autónoma del Estado de México, Instituto Politécnico Nacional.
8	Universidad Autónoma Aguascalientes, Universidad de Guanajuato.

The high presence of co-authorship reveals a pattern that is increasingly common in the social sciences, as reported in other bibliometric studies on the digitalization process in SMEs (Marino-Romero et al., 2023). However, these collaborations should become somewhat more internationalized. Joining efforts to study the benefits of DT for the development of SMEs from international perspectives could be positive insofar as collaboration implies at least two viewpoints or positions on the topic. In this way, strategies and technologies that have proven successful in other continents could even be transferred to the Latin American context, as shown by Burinskienė and Nalivaikė (2024).

Conceptual structure

Word co-occurrence was analyzed; this technique makes it possible to visualize the knowledge structure of a scientific field (Restrepo-Arango & Urbizagástegui-Alvarado, 2017). The analysis showed the presence of five clusters (Figure 6). The largest cluster included 11 words related to the following themes: performance, strategy, networks, dynamics, systems, knowledge, capabilities, orientation, perspective, dynamic capabilities, and entrepreneurial. This cluster reflects an interest in topics such as performance, knowledge, and entrepreneurship in SMEs. The additional clusters focus on the impact and performance of enterprises, innovation, growth, and development.

Figure 7 shows the thematic trends in SME digital transformation from 2014 to 2022. An increase in terms related to SME digital transformation was observed in the last five years, but the greatest growth occurred between 2020 and 2023, with the terms *performance, firm performance,* and *determinants*. During this same period, the most frequent theme was *performance*, with more than 40 occurrences.

The most frequent words in recent years reflect trending topics and are therefore recommended when searching for research themes. Some of these keywords have also appeared in previous bibliometric studies that have examined Industry 4.0 technologies in SMEs at a global level (Kumar & Kumar, 2023), digital transformation (DT) in general terms (Re et al., 2023), and specific aspects such as SME management worldwide (Marino-Romero et al., 2023). These consistencies indicate that research interests regarding DT in SMEs in Latin America share common features with studies on the same topic at the global level.

Thematic map

A thematic map is a way of representing core themes grouped according to the co-occurrence of keywords (Cosmo et al., 2021). In this map, the X-axis represents the degree of importance (centrality), and the Y-axis represents the degree of development (density) (Cobo et al., 2015). These axes form four quadrants that cluster different themes. Motor themes (upper left) display high centrality and development. The upper right quadrant represents niche themes (lower centrality but higher development). The lower right quadrant groups emerging and declining themes (low centrality and development).

Finally, the lower left quadrant groups basic themes (high importance but insufficient development). Figure 8 summarizes the thematic map on DT in SMEs; it was generated using the Walktrap algorithm configured with three words per cluster.

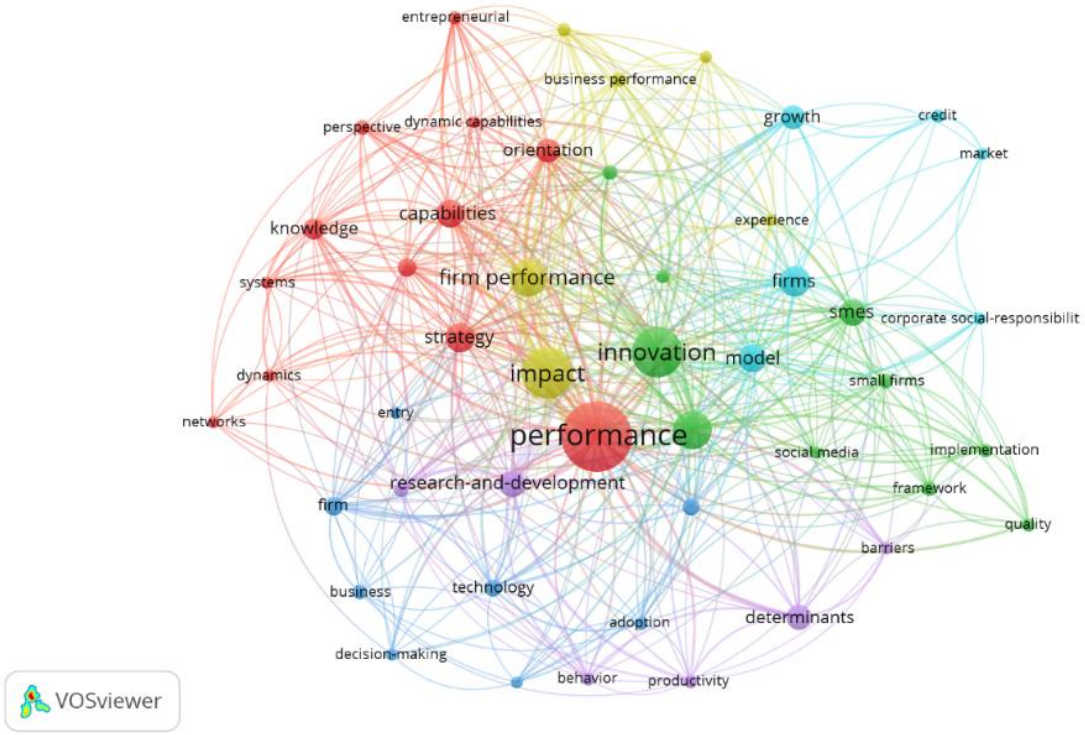

Figure 6. Clusters reflecting word co-occurrence.

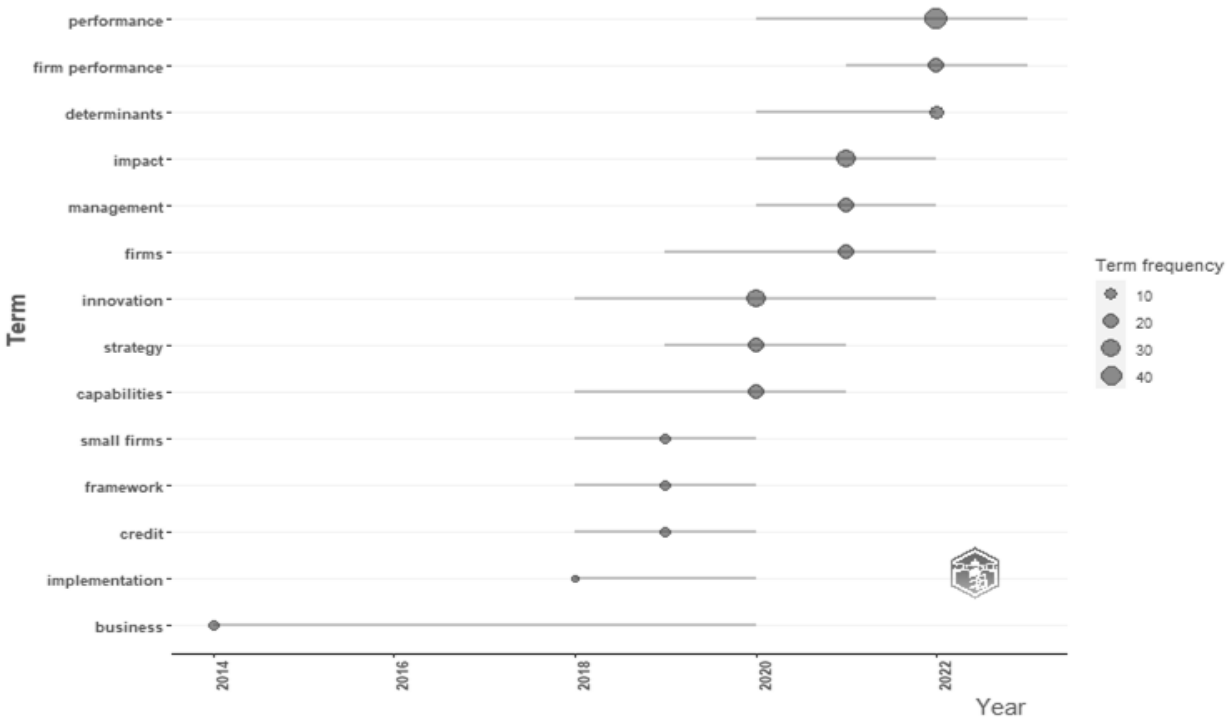

Figure 7. Thematic evolution based on the most frequently used keywords.

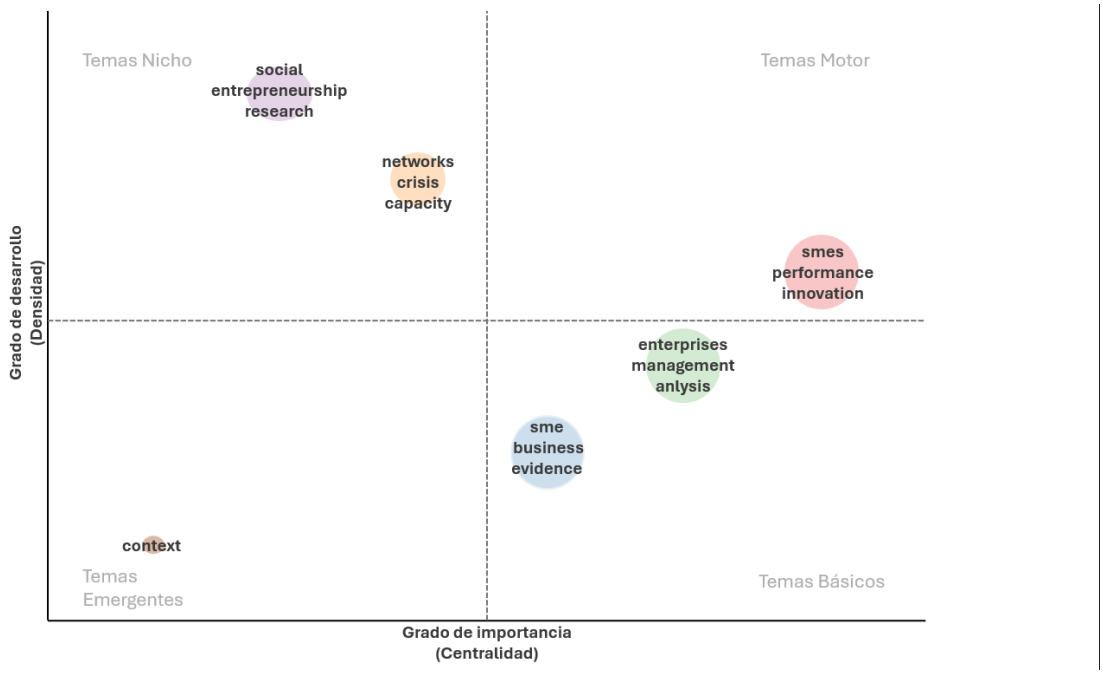

Figure 8. Thematic map of the analyzed scientific production.

In this map, the first word forming each cluster gives it its name. For the analysis, the articles that comprise each cluster were reviewed. From these, the cluster content was analyzed, and trends and gaps were identified.

Motor themes: In this quadrant, the theme SMEs stands out. Its articles emphasize the importance of applying statistical models for financial management and achieving higher SME performance (Florido et al., 2015). They also provide evidence that the adoption of information and communication technology increases business performance in SMEs (Cuevas et al., 2021). This is mainly based on creating algorithms or structural equation models with stored information to generate business benefits (Gallardo-Vázquez & Juárez, 2022). A gap identified in these themes is the need for research on innovation and disruptive improvements based on DT, from a sustainable perspective.

Niche themes: The *social* cluster brings together articles related to training, entrepreneurship in SMEs, and methodologies such as Lean Six Sigma and Open Innovation. This cluster analyzes how to create social value through knowledge transfer and shows a focus on researching internationalization (Felzensztein et al., 2022; Oura et al., 2016). The second theme in this quadrant is *networks*, which examines the post-pandemic financial crisis of some SMEs and how knowledge helps transform them. The studies focus on cooperation with external agents to face joint challenges such as eco-innovation, technological absorption capacity, and financial problems. Foreign networks in SME internationalization and their implications are also analyzed (Bai et al., 2022). Finally, there is research on the technological absorption capacity of SMEs (Kato, 2019).

Emerging or declining themes: One declining theme (*context*) was observed, showing low development in recent years, low centrality, and minimal impact. Studies in this cluster include marketing, competitiveness, economic welfare, exports, agriculture, supply chains, and research and development subsidies, among others (Hernani et al., 2013).

Basic themes: This quadrant shows two clusters with similar impact, although the *enterprises* cluster exhibits higher centrality and development. It emphasizes the documentation and digitalization of processes, which is essential for analyzing strategic options (Viltard, 2019). In agricultural companies, SMEs are opting to digitize processes that allow data analysis for decision-making, protection against crop diseases, climatic conditions, pest infections, and investment decisions for specific seasons (Zhai et al.,

2023). Likewise, digitalization related to business dissemination through social networks is addressed (Gutierrez-Leefmans & Holland, 2019), and research on investment in cybersecurity to reduce cyberattack risks is also included (Figueredo et al., 2022). This last topic represents a crucial aspect in the context of DT in SMEs; however, it has not reached sufficient development, making it an excellent gap for future research.

After analyzing thematic trends and gaps, it is important to note that DT is a driver for business models, capable of generating significant changes through its implementation (Telnov et al., 2022). Experts indicate that the primary challenge for implementing any DT element in an SME relates to financial issues (Del Do et al., 2023); therefore, further studies exploring these topics are necessary. Additionally, many SMEs disappeared during the COVID-19 pandemic, and surviving ones were strongly affected in their financial capacity, but little is known about how this situation hindered or affected their DT process. No studies were found addressing this topic, which emerges as a space for future research. It is also relevant to investigate SME finances in relation to DT models, as suggested by other researchers regarding twin transformation or double transformation (Digital and Sustainable Transformation) (Burinskienė & Nalivaikė, 2024).

Experts emphasize the importance of understanding that DT models could be measured by the companies' digital maturity level (Re et al., 2023; Telnov et al., 2022). Isolated studies on skills improvement and methodologies such as Six Sigma to enhance processes were identified (Jimenez et al., 2023), but there are no measures or parameters indicating how applicable and implementable DT technologies are in Latin American SMEs using these methodologies. There is no literature on the human factor in DT, which is an advanced topic in Europe (Scuotto et al., 2023) and requires investigation in Latin America.

Other DT topics have not been studied in Latin American SMEs but have received attention elsewhere. For example, enhancing the circular economy through DT (Salas-Vargas & Blas Yañez, 2023) to promote sustainability. Studies of this type could enable technological development combined with material reuse or circulation (Artacho-Ramírez et al., 2020).

Conclusion

This study accounts for the thematic development of DT in SMEs in the Latin American context. In addition to identifying the most relevant sources and authors for consultation, this bibliometric analysis revealed that research on DT in SMEs is growing within a collaborative authorship pattern that requires greater internationalization to gain a broader perspective and diverse approaches for regional development.

The thematic analysis highlighted relevant themes that require further development. Studies with a stronger component of predictive statistical analysis and greater specialization are suggested, examining each subcomponent and technological process accompanying the application of DT models in SMEs. Research on Cloud Computing, Internet of Things, artificial intelligence, and Big Data in SMEs is also needed. In this regard, studies should include specific aspects of DT related to SMEs.

Given the importance of the topic for regional development, its study should be promoted in undergraduate and postgraduate programs at Latin American universities. The gaps identified in this study range from DT component development to micro developments focused on digital transformation linked to environmental and sustainability advances. Future studies should also include the analysis of scientific production in other databases, as this study was limited to WoS, which, although an excellent database, does not encompass all sources publishing information on this topic.

Author contributions

Idea, project development, literature review (state of the art), methodology, data collection and analysis, results presentation, discussion, and conclusions: all authors; Draft writing: Luis Salmón and Javier Rojas; Final revisions: Bexi Perdomo; Approval for publication: all authors.

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