



Evolution of Digital Transformation and Sustainability in Microenterprises in Quevedo Canton: An Analysis Before, During, and After the Pandemic

Evolución de la transformación digital y sostenibilidad de las microempresas del cantón Quevedo: análisis antes, durante y después de la pandemia

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ABSTRACT

The objective of this study was to analyze the evolution of digital transformation and the perceived effects of digitization on the

sustainability of microenterprises in the Quevedo canton before, during, and after the COVID-19 pandemic. A quantitative approach was used, with a non-experimental, cross-sectional design, involving a survey administered to a sample of 364 microenterprises and a retrospective analysis of three periods: pre-pandemic, pandemic, and post-pandemic. The results showed that before the pandemic, digital adoption was in its early stages; during the health crisis, it accelerated primarily as a mechanism for adaptation and business continuity; and in the post-pandemic period, partial consolidation was observed. The perceived benefits were greater in the economic and social dimensions than in the environmental dimension, while barriers related to training, financing, and technological infrastructure persisted. It is concluded that digital transformation has evolved progressively, although strategic integration remains limited.

RESUMEN

La presente investigación tuvo como objetivo analizar la evolución de la transformación digital y los efectos percibidos de la digitalización sobre la sostenibilidad de las microempresas del cantón Quevedo antes, durante y después de la pandemia de COVID-19. Se empleó un enfoque cuantitativo, con diseño no experimental y transversal, mediante una encuesta aplicada a una muestra de 364 microempresas y una reconstrucción retrospectiva de tres periodos: prepandemia, pandemia y postpandemia. Los resultados evidenciaron que antes de la pandemia la adopción digital era incipiente; durante la crisis sanitaria se aceleró principalmente como mecanismo de adaptación y continuidad empresarial; y en la postpandemia se observó una consolidación parcial. Los beneficios percibidos fueron mayores en las dimensiones económica y social que en la ambiental, mientras persistieron barreras relacionadas con capacitación, financiamiento e infraestructura tecnológica. Se concluye que la transformación digital ha evolucionado de forma progresiva, aunque con una integración estratégica todavía limitada.

Keywords / Palabras clave

Digital transformation; microenterprises; business sustainability; post-pandemic.

Transformación digital; microempresas; sostenibilidad empresarial; postpandemia.

Introduction

In recent years, digitalization has become a recurring response to scenarios of economic uncertainty and production disruption. Nevertheless, in the case of microenterprises located in non-metropolitan areas of emerging economies, digital transformation processes tend to unfold under significant structural constraints, which limit their strategic scope and their impact on business sustainability. The COVID-19 pandemic intensified these dynamics, highlighting both the potential and the limitations of digitalization in this sector. Recent research highlights that the adoption of digital technologies can enable micro and small enterprises to develop dynamic capabilities, improve their operational efficiency, and expand their market reach, thereby contributing to their economic and organizational sustainability (Papadopoulos et al., 2020; Kraus et al., 2022; Al Omoush et al., 2023).

Microenterprises represent a particularly vulnerable segment due to their structural limitations in terms of capital, organizational capabilities, and access to technological resources. The COVID-19 pandemic marked a turning point for this business segment, abruptly accelerating the adoption of digital tools in production units that, in many cases, had only incipient levels of technological maturity. High-impact studies agree that, during the health crisis, digitalization ceased to be a gradual strategy and became an immediate mechanism for operational continuity and business survival, especially in microenterprises with limited financial and human resources (Papadopoulos et al., 2020).

Post-pandemic empirical evidence shows that the accelerated adoption of digital technologies did not necessarily lead to profound or strategic digital transformation processes in microenterprises. In many cases, this process manifested as a digital transformation characterized by fragmented and pragmatic adoptions, focused on low-cost, rapidly deployable tools, without systemic process integration or long-term digital planning (Mendoza Vargas et al., 2026a; Petropoulou et al., 2024).

The literature indicates that the limited depth of digital transformation is associated with persistent structural barriers, including a scarcity of internal resources and capabilities, a lack of digital training and skills, financial constraints, and organizational resistance to change (Petropoulou et al., 2024; Omowole et al., 2024). Added to these are

limitations in technological infrastructure and connectivity, which can widen the gaps in the digitization processes of microenterprises (Holl & Rama, 2024).

Various studies agree that the digital transformation of microenterprises does not depend solely on internal factors but is also shaped by the institutional environment. Although many countries have promoted public agendas and programs aimed at digitization and bridging the digital divide, their impact on this segment is often limited due to problems with coverage, accessibility, dissemination, and alignment with the actual capabilities of microenterprises—which creates a perception of insufficient or absent effective support (Dini et al., 2021).

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These limitations reinforce the need for external support and institutional intervention, underscoring the importance of the public policy environment as a key factor in facilitating digital transformation processes (Petropoulou et al., 2024). From a sustainability perspective, digitalization can have a positive impact on productivity and operational efficiency; however, these effects are not automatic and depend on the degree of technological adoption and the development of internal digital and organizational capabilities, which are particularly relevant in contexts of high technological uncertainty—a factor that limits the ability of micro and small enterprises to translate digitization into sustained performance improvements (Huong et al., 2024).

Despite growing academic interest in the digital transformation of micro and small businesses, there remains a shortage of studies analyzing the evolution of digital transformation over time and its relationship to business sustainability, especially in non-metropolitan areas. This gap is particularly evident in local contexts of emerging economies during the post-pandemic period, where the available evidence remains scattered and limited.

Recent literature indicates that, while studies on business digitization have increased significantly following the COVID-19 pandemic, few examine collectively the progress, barriers, and effects of digitization in intermediate regions outside major metropolitan centers (Dini et al., 2021; Petropoulou et al., 2024).

In response to this gap, this study aims to analyze the evolution of digital transformation and the perceived effects of digitization on the economic, social, and environmental sustainability of

microenterprises in the Quevedo canton before, during, and after the COVID-19 pandemic. From a contextualized quantitative and empirical approach, this research contributes to the academic debate on digital transformation and business sustainability, providing evidence from a local, non-metropolitan context that is relevant for understanding similar dynamics in other emerging economies.

Literature Review

Digital Transformation in Micro, Small, and Medium-Sized Enterprises (MSMEs): An Analytical Focus on Microenterprises

Digital transformation is understood as a process that goes beyond the simple adoption of technologies, involving organizational, strategic, and cultural changes aimed at improving value creation and business competitiveness. From a conceptual perspective, digital transformation involves the strategic integration of digital technologies to modify processes, organizational structures, and business models, with the aim of creating and capturing value in highly dynamic environments (Verhoef et al., 2021).

The COVID-19 pandemic acted as an exogenous crisis that prompted numerous micro and small businesses to adopt digital technologies with the goal of sustaining business continuity in the face of public health restrictions. However, evidence suggests that these adoptions did not always result in comprehensive digital transformation processes. In many cases, business responses were primarily reactive and focused on implementing specific digital solutions—such as e-commerce or the digitization of services—without involving a substantive reconfiguration of the underlying organizational processes (Parker et al., 2023).

In the scientific literature, this process is typically analyzed in aggregate within the framework of micro and small enterprises (MSEs). However, within this group, microenterprises exhibit significantly different organizational dynamics, operational capabilities, and structural constraints, which justify a specific analysis of this segment. Various studies indicate that limitations in financial resources, human capital, and organizational capabilities—though these will be addressed in greater detail later—tend to manifest more intensely in microenterprises, thereby shaping the depth and effects of digital transformation (Kraus et al., 2022).

Recent literature indicates that, in micro and small enterprises (MSEs), digital transformation typically unfolds in a gradual, fragmented, and highly context-dependent manner—more as a response to external pressures than as a result of formalized long-term digital strategies (Priyono et al., 2020). In this regard, various authors distinguish between operational digitization—focused on the use of basic tools such as social media, instant messaging, or digital payments—and strategic digital transformation, which involves the systemic integration of technologies into key processes, the reorganization of work, and the development of sustainable digital capabilities (Verhoef et al., 2021).

In developing countries, the adoption of digital technologies by SMEs is constrained by financial limitations, a lack of technological knowledge, and organizational readiness challenges—factors that limit the depth of digitization processes (Yuwono et al., 2024). Digital transformation in micro and small enterprises (MSEs) should be viewed as a socio-technical phenomenon, in which technology interacts with human and organizational factors. Recent studies highlight that the effective adoption of digital tools depends largely on the digital competencies of managers and staff, as well as on their willingness to learn and embrace organizational change.

In non-metropolitan areas, gaps in connectivity, financing, and institutional support limit the depth of digital transformation in MSMEs, reinforcing patterns of partial and uneven adoption (Holl & Rama, 2024). Consequently, digital transformation must be analyzed as a dynamic and heterogeneous process, whose scope and effects depend on the structural context in which it unfolds, with particular implications for microenterprises.

The Pandemic as a Catalyst for Digital Transformation

In microenterprises, external shocks such as the COVID-19 pandemic can trigger abrupt, reactive, and uneven processes of change due to their limited organizational resilience. From this perspective, digitization does not unfold as a progressive and cumulative process, but rather as a discontinuous and contextual change, marked by sudden advances and partial reconfigurations in response to external shocks. In this context, the COVID-19 pandemic acted as an exogenous catalyst that forcibly accelerated the adoption of digital technologies in micro and small businesses, without this necessarily implying a profound or strategic digital transformation (Loyola et al., 2024).

In this context, digitization focused primarily on low-cost, rapidly implementable solutions, giving rise to frugal digital transformation processes centered on organizational resilience rather than a comprehensive reconfiguration of the business model, particularly in emerging markets (Al Omoush et al., 2023).

Empirical evidence indicates that, during the health crisis, digitization primarily addressed the immediate need to maintain operational continuity rather than strategic reconfiguration processes (Kraus et al., 2020). In this context, the literature distinguishes between reactive changes—associated with the rapid adoption of basic digital tools—and structural changes, which involve the systemic integration of technologies, the redefinition of processes, and the development of long-term organizational capabilities (Li et al., 2018).

Digital Transformation and Business Sustainability

Digital transformation is associated in the literature with improvements in business sustainability; however, its impact is neither automatic nor uniform, especially in the case of microenterprises (Mendoza-Vargas et al., 2026b). Various studies agree that the effects of digitization depend on the level of technological integration, organizational capabilities, and the structural context in which firms operate (Dini et al., 2021).

Business sustainability is conceived as a multidimensional construct that integrates economic, social, and environmental dimensions (Cantele et al., 2024). Within this framework, digitalization can contribute to sustainability when it is coherently integrated into business processes; however, when its adoption is primarily instrumental, its scope tends to focus on operational improvements rather than profound organizational transformations (Verhoef et al., 2021).

From an economic perspective, digital transformation can impact productivity, sales, and operational efficiency by expanding market reach and optimizing internal processes. In microenterprises, these effects are primarily manifested through the use of social media, digital sales channels, and basic management tools, while more advanced levels of technological integration remain limited (OECD, 2020).

From a social perspective, digitization can strengthen capabilities and improve work organization, as well as facilitate more responsive

customer relationships; however, in microenterprises, these advances tend to be concentrated in operational uses and face barriers that limit their further development (Díaz Vásquez et al., 2024).

In the environmental dimension, digital transformation can indirectly contribute to reduced paper use, optimized logistics, and greater control over resources. In microenterprises, these effects are typically incremental and subordinate to immediate economic objectives, especially when technology adoption lacks an explicit environmental focus (González-Cruz et al., 2025).

In this regard, the analysis of corporate sustainability in microenterprises is particularly relevant, given that in this segment the benefits of digital transformation tend to be more fragile, heterogeneous, and dependent on the structural context.

Structural Barriers to Digital Transformation in Microenterprises

Structural barriers to digital transformation in microenterprises are understood as a set of persistent factors that limit the depth, continuity, and sustainability of digitization processes, and that cannot be explained solely by individual or short-term decisions. These barriers arise from the interaction between internal constraints on resources and capabilities, limitations in learning processes and technology adoption, organizational and technological constraints, economic and financial constraints, as well as an institutional environment that, in many cases, fails to respond effectively to the characteristics and needs of the microenterprise segment. The literature indicates that the accumulation of these barriers limits the depth of digital transformation in microenterprises and hinders their evolution toward more integrated and strategic processes (Petropoulou et al., 2024).

One of the core elements of these structural barriers relates to a shortage of internal resources and capabilities. Various studies highlight that microenterprises face significant limitations in terms of financial resources, digital capabilities, and organizational capabilities, which restrict their ability to systematically integrate digital technologies and sustain transformation processes over time. In this context, digitalization tends to focus on low-cost, rapidly implementable solutions, without strategic alignment with organizational processes or long-term objectives (Petropoulou et al., 2024).

From a sustainability perspective, it has been noted that the degree of technological adoption and the development of internal digital and organizational capabilities are critical for digitization to generate sustained improvements in economic and organizational performance— conditions that are typically more limited in micro and small enterprises, especially in contexts of high technological uncertainty (Huong et al., 2024).

Added to these limitations are barriers associated with the processes of learning and technology adoption. The adoption of digital tools in microenterprises typically relies predominantly on informal learning mechanisms, centered on the business owner or manager, which restricts the systematic adoption of technologies and hinders their integration into organizational processes. This type of learning, which is highly dependent on individual experience, limits the internal dissemination of digital knowledge and the development of collective capabilities within the organization, reinforcing fragmented adoption dynamics and limiting the depth of digital transformation processes (Omowole et al., 2024; Petropoulou et al., 2024).

The lack of training and digital skills constitutes another persistent structural barrier to digital transformation in microenterprises. The literature shows that insufficient digital skills limit the productive use of technologies and hinder their integration into organizational processes, reinforcing digitization strategies with limited strategic scope. This lack of skills not only affects the initial adoption of digital tools but also the ability of microenterprises to scale up and sustain digital transformation processes beyond immediate, reactive responses to changes in the environment (Holl & Rama, 2024).

Economic and financial constraints also represent a significant structural obstacle. Financial limitations hinder investment in more complex technologies, the procurement of specialized services, and the implementation of long-term digital transformation processes, favoring the adoption of low-cost, rapidly deployable solutions. These constraints reinforce an approach to digitization focused on operational continuity and the resolution of immediate problems, to the detriment of deeper and more sustainable organizational restructuring processes (Petropoulou et al., 2024).

At the organizational level, resistance to change has been identified as an additional barrier to digital transformation in microenterprises. This resistance manifests itself in difficulties in redefining processes,

modifying established routines, and incorporating new practices associated with the use of digital technologies. The persistence of rigid organizational structures and traditional practices limits the systemic integration of digital technologies and contributes to the prevalence of superficial or incremental digital transformations (Omowole et al., 2024).

Technological and infrastructural barriers also play a central role in the digital transformation of microenterprises. In particular, limitations have been identified regarding effective access, stability, and affordability of connectivity, as well as the availability of adequate technological infrastructure. Evidence shows that, even in contexts where progress has been made in expanding digital infrastructure, significant gaps persist in the productive and sustained use of technologies, especially in the microenterprise segment, which deepens territorial and sectoral inequalities in digitization processes (Holl & Rama, 2024).

Structural barriers are reinforced by institutional constraints. Various studies agree that the digital transformation of microenterprises does not depend exclusively on internal factors but is shaped by the institutional environment in which they operate. Although many countries have promoted public agendas and programs aimed at digitalization and bridging the digital divide, their impact on microenterprises is often limited due to problems with coverage, accessibility, dissemination, and alignment with the actual capabilities of this segment, which creates a perception of insufficient or absent effective support (Dini et al., 2021).

During the COVID-19 pandemic, these institutional barriers became particularly evident. Empirical evidence shows that many microenterprises faced significant difficulties in accessing public support programs due to issues of coverage, targeting, and administrative requirements, which limited their ability to strengthen digital capabilities beyond immediate and short-term adaptation strategies (Cirera et al., 2021). These limitations underscore the need for external support and sustained institutional intervention to facilitate deeper and more strategic digital transformation processes in the microenterprise sector (Petropoulou et al., 2024).

Taken together, the literature suggests that structural barriers to digital transformation in microenterprises do not operate in isolation but rather accumulate and reinforce one another, thereby determining

the depth and sustainability of digitization processes. This interplay of barriers helps explain the prevalence of digital transformation processes that are partial and limited in scope and poses significant challenges for linking digital transformation to economic, social, and environmental sustainability—an aspect discussed in the following sections (Petropoulou et al., 2024; Huong et al., 2024).

Integrative Conceptual Approach of the Study

This study adopts an integrative theoretical approach that conceives of digital transformation in microenterprises as a contextual, dynamic, and nonlinear process, shaped by structural constraints and the organizational and institutional environment. From this perspective, digitization is not understood as a uniform adoption of technology, but rather as a heterogeneous trajectory determined by organizational capabilities, available resources, and the territorial context (Vial, 2019; Omowole et al., 2024).

Within this framework, the COVID-19 pandemic is interpreted as an exogenous accelerator that spurred the adoption of digital tools, without necessarily guaranteeing profound and sustained digital transformation processes. This acceleration was primarily a response to immediate needs for operational continuity, giving rise to reactive digitization strategies, whose consolidation in the post-pandemic period has been limited by persistent barriers related to training, financing, connectivity, and institutional support (Papadopoulos et al., 2020; Petropoulou et al., 2024).

Furthermore, the approach recognizes that the effects of digital transformation on economic, social, and environmental business sustainability are neither automatic nor uniform, but rather depend on the degree of technological adoption and the capacity of microenterprises to integrate digitization into their organizational processes and practices.

Methodology

The study employed a cross-sectional design with retrospective temporal reconstruction, using structured guided recall questions aimed at gathering information on the behavior of microenterprises during three phases: pre-pandemic (≤ 2019), pandemic (2020–2021), and post-pandemic (2022–2024). This strategy allowed for a retrospective comparison of the reported patterns of digital adoption

across the different periods, without constituting a longitudinal design.

A quantitative approach was adopted, based on the collection of numerical data through a structured survey and its subsequent statistical processing, to facilitate the systematic analysis of the information gathered.

Digital transformation was operationalized using indicators of the adoption and use of digital tools in the areas of digital presence, internal processes, sales and payments, and eco-digital practices. Business sustainability was addressed from a multidimensional perspective, considering economic, social, and environmental dimensions, measured through indicators of perception regarding the effects of digitization in the post-pandemic period.

The unit of analysis consisted of microenterprises operating in the Quevedo canton, with owners, managers, or those directly responsible for business management serving as respondents due to their knowledge of the microenterprise's activities, processes, and decisions.

The reference population consisted of 6,643 microenterprises in the Quevedo canton for the year 2023, according to information from the Statistical Registry of Companies and Establishments (REEM) reported by Alvarado Morante and Quinto Parra (2024). This figure was used because it represented the most recent official data available for the canton at the time the study's reference population was established.

Table 1. *Microenterprises in the Quevedo Canton – Los Ríos – Ecuador (2019–2023)*

Microempresas del cantón Quevedo – Los Ríos – Ecuador (2019–2023)					
Tipo de empresa	2019	2020	2021	2022	2023
Microempresa	7.121	7.001	7.085	6.975	6.643

Source: Prepared by the authors based on Alvarado Morante and Quinto Parra (2024), using data from the 2023 REEM.

Sample Size and Sampling Procedure

To determine the sample size, the formula for finite populations was used, considering a population of 6,643 microenterprises, a reference confidence level of 95%, a precision of 5%, and $p = q = 0.5$ —a conservative criterion used when the expected proportion is unknown. Based on these parameters, a sample size of 364 microenterprises was established.

Subsequently, non-probability quota sampling was applied, using the sector of economic activity as the classification criterion. To guide the sectoral distribution of the sample, the proportions reported by Vera (2021)—based on INEC data from 2014—were used as a reference. This reference was used solely as a criterion for establishing sectoral quotas and not as an estimate of the sectoral structure of microenterprises in 2023. The sample consisted of 100 microenterprises in the manufacturing sector, 93 in the service sector, and 171 in the trade sector.

Table 2. *Distribution of the Sample by Quotas According to Economic Activity Sector*

Economic Activity Sector	Distribution %	Sample
Productive	27.55%	100
Services	25.46%	93
Retail	46.99%	171
Total	100%	364

Source: Author's own calculations based on the sectoral proportions reported by Vera (2021).

According to the distribution used to establish the quotas, the commerce sector received the largest number of sample units, followed by the manufacturing and services sectors. This distribution made it possible to include all three sectors considered in the study.

Data Collection Method and Instrument

The data collection method was a survey, and a structured questionnaire aligned with the study's objectives and dimensions was used as the instrument. Items related to corporate sustainability were measured using a five-point Likert scale.

The instrument was organized into three analytical blocks:

Demographic and organizational profile (gender, age, education level, sector, years in operation, size by number of employees, business formalization).

Digital transformation (indicators related to the adoption of digital tools and practices).

Sustainability (economic, social, and environmental indicators regarding the perceived effects of digitization).

Reliability of the instrument

To assess the internal consistency of the section on corporate sustainability—whose items were measured using a Likert scale—Cronbach's alpha coefficient was calculated. Values of $\alpha = 0.78$ were obtained for the economic dimension, $\alpha = 0.81$ for the social dimension, and $\alpha = 0.75$ for the environmental dimension, while the overall scale achieved an $\alpha = 0.83$. These results demonstrated adequate internal consistency of the scales used to measure the perceived effects of digitalization on corporate sustainability.

Temporal Measurement Strategy

The study considered three time periods for analysis: pre-pandemic (≤ 2019), pandemic (2020–2021), and post-pandemic (2022–2024). For the pre-pandemic and pandemic periods, structured guided-recall questions were used to gather information on business performance in areas related to digital presence, sales through digital channels, digital payments, process reorganization, and barriers to technology adoption. The post-pandemic period was assessed using questions regarding the business situation during the most recent period covered by the study.

The information was collected through a single administration of the questionnaire, organized into sections corresponding to the different time periods; therefore, the results represent a retrospective reconstruction based on the respondents' answers rather than longitudinal measurements taken at different points in time.

Data Analysis Plan

Descriptive analysis: frequencies, percentages, and, where appropriate, measures of central tendency to characterize the demographic and organizational profile of microenterprises.

Descriptive comparative analysis: comparison of digital adoption patterns between the pre-pandemic (≤ 2019), pandemic (2020–2021), and post-pandemic (2022–2024) periods.

Perception Analysis: Percentage distribution of responses obtained using a five-point Likert scale to analyze the perceived effects of digitalization on the economic, social, and environmental dimensions of business sustainability.

Ethical Considerations

Participation by respondents was voluntary and conducted with informed consent. The confidentiality of the collected information was guaranteed, and it was used exclusively for academic purposes. The results were presented in aggregate form, without identifying the individuals or participating microenterprises.

Results.

Demographic Data and Organizational Assessment of Microenterprises in the Quevedo Canton

This section presents the main demographic and organizational characteristics of microenterprises in the Quevedo canton, with the aim of contextualizing the sector's structural profile and establishing the empirical basis for the subsequent analysis of digital transformation and its effect on business sustainability.

Table 3. *Demographic and Organizational Profile of Microentrepreneurs in the Quevedo Canton*

Dimension	Observed distribution in the sample
Gender	Predominance of females (52.20%), followed by males (44.80%), and finally those who preferred not to say (3%)
Age	Highest concentration in the 26–30 age group (35.16%) and the 31–35 age group (24.18%), followed by the 18–25 age group (21.98%), those over 41 (10.99%), and the 36–40 age group (7.69%).

Business Sector	The retail sector predominated (46.99%), followed by the manufacturing sector (27.55%) and the service sector (25.46%).
Educational Level	Most have a high school education (51.40%), followed by college education (30.20%), elementary school (15.10%), and postgraduate education (3.30%).
Length of Business Operation	66.66% of businesses have been in operation for 1 to 6 years; 20.00% for 6 to 9 years; and 13.34% are businesses that have been in operation for less than 1 year or more than 10 years.
Number of Employees	The average is 2.13 employees per business, with a median and mode of 2 employees. 46.67% have two employees; 26.67% have between 3 and 5 employees; and 26.66% have one or no employees, meaning they are solely self-employed
Formal Registration (RUC)	80.00% of the businesses are registered with the Single Taxpayer Registry (RUC), while 20.00% are not formally registered.

Source: Prepared by the author based on a survey of microenterprises in the Quevedo canton.

The results presented in Table 3 allow us to outline the structural profile of microenterprises in the Quevedo canton and to understand the organizational context in which their digital transformation and sustainability processes are taking place.

In terms of gender, business management shows a slightly higher participation of women, indicating a significant female presence in the management of microenterprises in the Quevedo canton.

The age structure of microentrepreneurs reveals a predominance of young managers, indicating a business ecosystem in the early stages of organizational development. This demographic profile is a key factor for later contextualizing patterns of digital tool adoption.

From a sectoral perspective, commercial activity accounts for the largest proportion of microenterprises, followed by manufacturing and services. This composition reflects a business structure primarily oriented toward the local market and direct interaction with consumers, where competitiveness depends largely on visibility, communication, and operational efficiency. The educational level of business owners is characterized by a predominance of secondary

education, with a smaller proportion of entrepreneurs holding higher education degrees.

Regarding the age of the businesses, most microenterprises are in an early or intermediate stage of operation, reflecting a business landscape in the process of stabilization. This phase of the organizational life cycle is particularly sensitive to strategic decisions aimed at efficiency, operational continuity, and adaptation to the competitive environment.

The size of the businesses indicates a small operational scale, with a predominance of production units with few employees and a significant presence of self-employment. This characteristic limits the possibilities for expansion through workforce growth and reinforces the importance of alternative strategies for improving performance, including the adoption of digital solutions that allow for expanding commercial reach and optimizing processes without significantly increasing the organizational structure.

The level of formalization shows that most microenterprises are legally registered, although a significant segment of businesses continues to operate informally. This institutional duality defines a heterogeneous context for the adoption of formal digital practices, especially those related to invoicing, payment methods, and administrative management.

As has been shown, the results paint a picture of an ecosystem of microenterprises that is predominantly female, young, and small-scale, with an average level of education and a strong focus on commerce. This profile helps explain why technology adoption tends to be concentrated on basic digital tools and, at the same time, defines the conditions necessary to move toward a more profound and sustainable digital transformation. Building on this structural foundation, the following section analyzes the results related to the adoption and use of digital technologies in the pre-, during, and post-pandemic phases, and their effect on the sustainability of microenterprises in the Quevedo canton.

2. Digital Adoption by Microenterprises in Quevedo—Pre-pandemic Period (≤ 2019)

During the pre-pandemic period (≤ 2019), microenterprises in the Quevedo canton showed early-stage digital adoption, which was fragmented and primarily instrumental. Digitization was concentrated

on specific uses (for example, occasional social media presence or basic record-keeping), without being systematically integrated into business or administrative processes. Consequently, an in-person and manual operating model predominated, with low use of digital sales channels, electronic payment methods, and eco-digital practices linked to sustainability.

Table 4. *Digital Adoption by Microenterprises in Quevedo During the Pre-Pandemic Period (≤ 2019)*

Dimension	Indicator	Statistical result	Analytical Interpretation
Digital presence	Active social media page (Facebook / Instagram)	Yes: 30% No: 70%	Most operated without an active digital presence, indicating that social media was not a high priority as a business channel and that visibility and positioning were limited prior to the health crisis.
	Customer service via messaging apps (WhatsApp)	Yes: 35% No: 65%	The use of WhatsApp for customer service was still limited in the pre-pandemic period.
	Frequent posting of content or promotions	Yes: 20% No: 80%	Frequent posting of content or promotions saw limited adoption,
Internal processes	Digital sales tracking (Excel, system, app)	Yes: 35% No: 65%	Manual recording predominates; the use of basic tools is rare, reflecting low traceability and limited data-driven management.
	Inventory control using a digital tool	Yes: 20% No: 80%	Inventory control using digital tools showed limited adoption.
	Digital invoicing or receipts	Yes: 30% No: 70%	Digital invoicing was not yet a widespread practice among microenterprises.
Sales and payments	Sales through digital channels (social media, WhatsApp, website)	Yes: 10% No: 90%	Digital sales were rare and not integrated into the business model; there was a high reliance on in-person transactions and local consumption.
	Acceptance of digital payments (bank transfers, cards, apps)	Yes: 25% No: 75%	Non-digital payment methods predominated, while the adoption of bank transfers, cards, or apps was still limited.

Eco-friendly practices	Reducing paper use through digital records	Yes: 20% No: 80%	The reduction in paper use through digital records showed a limited level of adoption.
	Procedures or administrative tasks completed digitally	Yes: 30% No: 70%	In-person administrative procedures persisted; the use of digital platforms was occasional, which limited efficiency and operational continuity in the event of contingencies.

Source: Compiled by the author based on a survey of microenterprises in the Quevedo canton

With regard to the results in Table 4, in operational terms, the adoption of digital tools in the internal processes of microenterprises in the Quevedo canton was limited and inconsistent. The use of digital sales records reached only 35%, while inventory control via digital tools was as low as 20%, indicating significant constraints on information-based management and process standardization. This situation is associated with longer operational times, a greater propensity for recording errors, and a reduced ability to respond to fluctuations in demand, thereby affecting operational efficiency and management capacity.

Additionally, invoicing using some form of digital medium remained at low levels, suggesting that the adoption of digital administrative tools was not a widespread practice but depended largely on the levels of formalization and the existing administrative capabilities of each production unit. In this context, digitization appears to be more closely associated with individual initiatives by business owners than with established organizational processes.

In the commercial sphere, the digitization of the sales process was marginal. Sales through digital channels were exceptional (10%), and the acceptance of digital payment methods was limited to 25%, creating a structural constraint on the completion of the digital transaction cycle. Even in cases where there was some degree of social media presence or use of instant messaging, reliance on cash reduced the conversion of digital interactions into actual sales, reinforcing the central role of in-person channels and local consumption.

Regarding eco-digital practices, the results show nascent levels: the reduction in paper use through digital records reached 20%, while the completion of procedures or administrative tasks digitally reached 30%. These results demonstrate that, in the pre-pandemic period,

digitization practices linked to the environmental dimension were still in their early stages.

Overall, the pre-pandemic period was characterized by nascent, fragmented, and largely unstrategic digitization, with a predominance of in-person interactions and low integration of digital technologies into internal, commercial, and administrative processes. This scenario serves as a key starting point for interpreting the subsequent evolution of digitization during the 2020–2021 period, as the transformations observed occurred against a backdrop of heterogeneous capabilities and structural limitations in management, payments, and process integration.

Digital Transformation of Microenterprises in the Quevedo Canton During the Pandemic (2020–2021)

During the COVID-19 pandemic (2020–2021), microenterprises in the Quevedo canton underwent an accelerated digital transformation, driven by mobility restrictions, the temporary closure of in-person activities, and the abrupt drop in traditional demand. Unlike the pre-pandemic scenario, which was characterized by nascent and fragmented digitization, this period was marked by the intensive adoption of basic digital tools, aimed primarily at sustaining operations, maintaining contact with customers, and facilitating commercial transactions amid high uncertainty.

Table 5. *Digital Transformation of Microenterprises in Quevedo During the Pandemic (2020–2021)*

Dimension	Indicator	Statistical result	Analytical Interpretation
Use of market-oriented digital technologies	Implemented WhatsApp Business or structured digital customer service	Yes: 65% No: 35%	Digital messaging established itself as the primary channel for communication and customer service, partially replacing in-person interaction and enabling operational continuity during the lockdown.
	Increased the use of social media for sales	Yes: 70% No: 30%	Social media took on a central role as a direct marketing channel, becoming the primary

			means of generating visibility, attracting customers, and sustaining revenue.
	Implemented digital payments	Yes: 55% No: 45%	Significant progress has been made in the adoption of electronic payments; however, their implementation has not been universal, highlighting gaps in financial inclusion and trust in technology.
	Implemented home delivery or digital coordination	Yes: 60% No: 40%	Digital logistics emerged as a key component for enabling sales in contexts of mobility restrictions, especially in commerce and services.
Organizational and Process Transformations	Reorganized internal processes using digital tools	Yes: 60% No: 40%	The pandemic forced a reconfiguration of internal routines, promoting the use of digital tools for coordinating, monitoring, and tracking activities.
	Staff quickly learned to use digital tools	Yes: 75% No: 25%	The rapid adoption of digital tools demonstrates microbusinesses' adaptive response to the demands created by the pandemic.
	Procedures with suppliers or customers were digitized	Yes: 65% No: 35%	Digitizing procedures made it possible to maintain business and administrative relationships, reducing time, costs, and reliance on in-person interactions.
	Limitations in adequate technological	Yes: 45%	Connectivity and equipment constraints

Structural barriers to digitization	infrastructure hindered digitization	No: 55%	limited the depth and stability of digitization, especially in smaller-scale businesses.
	A lack of digital training was a significant barrier	Yes: 70% No: 30%	The lack of digital skills was the main structural barrier to more advanced and sustainable adoption of technologies.
	Lack of funding was a significant barrier	Yes: 65% No: 35%	Financial constraints limited the ability to invest in more far-reaching digital solutions.

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Source: Compiled by the author based on a survey of microenterprises in the Quevedo canton

The results presented in Table 5 show that, during the COVID-19 pandemic (2020–2021), microenterprises in the Quevedo canton experienced an acceleration of digital transformation. Unlike the pre-pandemic period, which was characterized by limited digital adoption, the use of digital tools—primarily aimed at maintaining communication with customers, sales, and operational continuity—intensified during the health crisis.

The widespread adoption of digital messaging (65%) and social media for sales (70%) reflects a clear shift toward digital channels for interaction and marketing. These tools established themselves as key channels for interaction and marketing during restrictions on in-person activity.

Likewise, the incorporation of digital payments (55%) and home delivery systems or digital logistics coordination (60%) demonstrates significant progress in the digitization of the business cycle. However, the fact that these percentages do not reach widespread levels reveals that the transformation was uneven and incomplete, influenced by structural factors such as available technological infrastructure and financial inclusion.

From an organizational perspective, the results show that digital transformation was not limited to the adoption of tools but involved substantive changes in the way work is organized. The reorganization of internal processes (60%), the digitization of procedures with

customers and suppliers (65%), and accelerated staff training (75%) reflect the development of adaptive capabilities aimed at ensuring operational continuity in a highly disruptive environment. However, these processes were primarily characterized by their reactive nature in response to the conditions imposed by the pandemic.

The identified barriers help explain the limitations of this transformation. The lack of digital training (70%) emerges as the main obstacle to consolidating and deepening technological changes, followed by budgetary constraints (65%) and infrastructure limitations (45%). These barriers help explain why digitization during the pandemic focused on basic tools and did not, in most cases, lead to integrated or strategic digital models.

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Overall, the digital transformation of microenterprises in the Quevedo canton during the pandemic was characterized by accelerated, reactive, and functional adoption, geared toward survival rather than long-term optimization. Although this process helped sustain economic activity in the short term, it left unresolved challenges in terms of training, technological integration, and sustainability—challenges that take on particular relevance in the analysis of the post-pandemic period.

Perceived Effects of Digitalization on Sustainability—Post-Pandemic (2022–2024) _ Microenterprises in the Quevedo Canton

In the post-pandemic period (2022–2024), digitalization ceased to function exclusively as a reactive survival strategy—a characteristic of the health crisis period—and began to take root as part of the standard practices of microenterprises in the Quevedo canton. In this context, the evaluation focused on analyzing the perceived effects of the continued use of digital tools on the economic, social, and environmental dimensions of business sustainability.

The data for the post-pandemic period (2022–2024) was derived from respondents' self-reported perceptions, collected through a field survey conducted in 2024 and measured using a Likert scale designed to identify trends, perceptions, and perceived effects of digitalization on post-pandemic sustainability. The measurement used a five-point scale (1 = strongly disagree; 5 = strongly agree), focusing on microentrepreneurs' perceptions of the effects of digitalization on their sustainable performance.

Table 6. *Perceived Effects of Digitalization on the Sustainability of Microenterprises in the Quevedo Canton (Post-Pandemic Period 2022–2024)*

Dimension	Indicator	Likert Distribution (%)	Analytical Interpretation
Economic	Digitization increased customer/market reach.	1=5%, 2=10%, 3=20%, 4=40%, 5=25%	A high concentration of agreement levels (4–5 = 65%) suggests that the consolidation of digital channels expanded commercial visibility and access to new demand segments.
	Digitization increased sales or purchase frequency.	1=8%, 2=12%, 3=25%, 4=35%, 5=20%	Moderate agreement predominates, reflecting a favorable perception of the effect of digitization on sales.
	Digitization reduced operating costs (time, transportation, management).	1=12%, 2=18%, 3=30%, 4=25%, 5=15%	Moderate impact (4–5 = 40%): savings in management and coordination coexist with costs associated with connectivity, training, and technology implementation.
	Digitization improved business productivity/efficiency.	1=6%, 2=12%, 3=22%, 4=38%, 5=22%	Favorable trend (4–5 = 60%), associated with process reorganization and sustained use of digital tools in day-to-day operations.
Social	The business developed digital skills among its staff.	1=7%, 2=13%, 3=25%, 4=37%, 5=18%	The majority acknowledges progress (4–5 = 55%), consistent with accelerated learning processes initiated during the pandemic.
	Customer service and customer relations were improved (speed, follow-up).	1=6%, 2=10%, 3=22%, 4=40%, 5=22%	Positive result (4–5 = 62%): Digitalization enhances response speed, follow-up, and the customer experience.
	Jobs were created or preserved thanks to digitalization.	1=15%, 2=20%, 3=30%, 4=23%, 5=12%	Weak–moderate effect (4–5 = 35%): Digitalization contributes more to sustaining business continuity than to creating net employment.

	Work organization (roles, schedules, coordination) was improved.	1=10%, 2=18%, 3=28%, 4=30%, 5=14%	Moderate impact (4–5 = 44%), contingent on the level of formalization and standardization of internal processes.
Environmental	Paper use was reduced through digitization.	1=8%, 2=14%, 3=28%, 4=32%, 5=18%	Intermediate result (4–5 = 50%): Administrative digitization reduces paper use, although certain habits and physical requirements persist.
	Logistics and deliveries (routes/coordination) were optimized through digital tools.	1=12%, 2=20%, 3=30%, 4=26%, 5=12%	Moderate-to-low impact (4–5 = 38%): Logistics optimization is gradual and depends on volume, coordination, and technological capabilities.
	Control over resources and supplies has improved thanks to digital records.	1=10%, 2=18%, 3=30%, 4=28%, 5=14%	Moderate effect (4–5 = 42%): Digital records improve control, although the adoption of inventory systems remains limited.

Source: Prepared by the author based on a survey of microenterprises in the Quevedo canton

In line with Table 6, the results from the post-pandemic period show that microentrepreneurs perceive favorable effects of digitization on sustainability, particularly in its economic dimension. The greatest perceived impact is observed in the expansion of market reach, improved productivity, and, to a lesser extent, increased sales, suggesting that the digital channels established after the pandemic continue to function as mechanisms for generating and stabilizing revenue.

In the social dimension, digitalization has positive effects on strengthening digital skills, customer service, and work organization. However, the perceived effect on job creation or retention is smaller, which is consistent with the small-scale operational structure observed in microenterprises and the predominance of self-employment. In this regard, digitization contributes primarily to sustaining existing employment continuity rather than expanding the workforce.

Progress in the environmental dimension has been more gradual. The reduction in paper use and improved resource management reflect indirect benefits of administrative digitization, while logistics optimization has had a more limited impact, constrained by operational capacity and the level of business formalization. These

results show that the perceived effects of digitization are less favorable in the environmental dimension than in the economic and social dimensions.

Overall, evidence from the post-pandemic period indicates that digitization in microenterprises in the Quevedo canton has transitioned from a reactive adoption phase to a phase of progressive consolidation, with more clearly perceived effects on economic and social sustainability than on environmental sustainability.

Discussion

A notable aspect of the microenterprise profile analyzed is the high participation of women in business management. Although gender is not a central variable in the study, this finding can be interpreted in light of recent studies in Latin America that highlight the resilience and adaptation strategies deployed by women entrepreneurs during the pandemic to sustain their businesses (Jahanshahi et al., 2024).

The study's results confirm that the digital transformation of microenterprises in the Quevedo canton does not follow a linear or homogeneous trajectory, but rather an evolution shaped by the context, in which the adoption of digital tools has focused on solutions with a low barrier to entry and rapid operational impact. This finding confirms that digitization in microenterprises develops primarily as an adaptive strategy, geared more toward survival and market sustainability than toward a structural transformation of the business model.

In particular, the current use of digital tools shows a clear preference for interaction and marketing platforms, such as social media, while the adoption of more structured solutions, such as proprietary websites or integrated systems, is limited. This empirical pattern is consistent with the evidence reported by Gutiérrez et al. (2025), who note that, in Ibero-American contexts, micro and small enterprises tend to prioritize technologies compatible with their existing capabilities and with lower investment and specialized knowledge requirements. In this sense, Quevedo's findings do not reflect an absence of digitization, but rather selective digitization, aligned with internal constraints and environmental conditions.

Based on the interpretation of the results, the COVID-19 pandemic acts as an exogenous accelerator of the digitization process, but not as an automatic trigger for profound transformation. Empirical evidence

shows that, although the use of digital tools intensified during the pandemic, post-pandemic consolidation remains at intermediate levels—a pattern consistent with evidence on digital transformation and maturity among Ecuadorian small businesses in the post-pandemic period (Mendoza Vargas et al., 2026a). This dynamic aligns with the findings of Cardoso et al. (2025), who argue that external shocks can accelerate technology adoption without necessarily generating sustained structural changes if there are no pre-existing organizational capabilities to integrate the technology into business processes and routines.

This empirical evidence reinforces the idea that pandemic-induced digitalization primarily responded to immediate adaptation needs, without guaranteeing profound organizational transformations, as noted in the literature on changes in business models in crisis contexts (Seetharaman, 2020).

A key finding of the study is the identification of training and financing as the primary needs for advancing digitalization. From an interpretive perspective, this result indicates that the ability of microenterprises to strategically adopt technologies constitutes one of the main challenges to advancing digitalization. Gutiérrez et al. (2025) emphasize that training in digital skills and owner leadership are critical factors for advancing toward higher levels of digital maturity, which explains why, in the absence of these elements, transformation remains at an operational level.

With regard to financial constraints, the results suggest that this barrier acts as an obstacle to the scaling up of digitalization. Although microenterprises have managed to incorporate basic digital tools, moving toward more complex solutions requires sustained investments that many companies are unable to make. Wang et al. (2025) note that digitalization can help alleviate financial constraints in innovative firms; however, this effect depends on the existence of internal capabilities that enable the transformation of technology into performance improvements, which aligns with the limited depth of digitalization observed in the case of Quevedo.

With regard to business sustainability, the results show a positive but heterogeneous impact of digital transformation. The effects are most evident in the economic and social dimensions—improved operational efficiency, expanded market reach, and strengthened customer relationships—while the effects in the environmental dimension are

moderate and largely indirect. This empirical evidence is consistent with the findings of González-Cruz et al. (2025), who argue that digitization contributes to sustainability when it is linked to innovation processes and an explicit strategic orientation; otherwise, environmental benefits tend to be incremental and subordinate to immediate economic objectives.

From a comparative perspective, the results obtained in Quevedo are consistent with recent evidence from emerging economies, where structural barriers and the institutional environment determine the depth of digital transformation. National and institutional factors influence the ability of firms to turn digitalization into sustainable competitive advantages, reinforcing the idea that digital transformation cannot be analyzed in isolation from the environment in which micro and small enterprises (MYPES) operate.

Based on the above, the discussion supports the conclusion that the digital transformation of microenterprises in the Quevedo canton shows partial consolidation, characterized by significant adoption of basic digital tools, persistent limitations to deepening the transformation, and varying perceived effects on business sustainability. This finding provides empirical evidence from a local context that aligns with the international literature and is consistent with the findings of Li et al. (2018), who note that digital transformation in small businesses depends critically on the development of organizational and managerial capabilities, and not solely on the incorporation of digital technologies.

The findings of this study reinforce the need for comprehensive approaches that prioritize capacity building, access to financing, and institutional support as enabling conditions for advancing toward deeper and more sustainable digital transformation processes. In the absence of such capacities, digitization tends to generate short-term improvements in operational efficiency without translating into structural transformations or sustained impacts on long-term business sustainability. In this regard, the study provides empirical evidence from a non-metropolitan area in an emerging economy, contributing to the understanding of how digitization in microenterprises unfolds as an adaptive and heterogeneous process, with varying effects on business sustainability.

Conclusions

The study shows that digital transformation in microenterprises in the Quevedo canton has followed a trajectory of accelerated but incomplete evolution, characterized by incipient digitization in the pre-pandemic stage, forced and predominantly reactive adoption during the health crisis, and partial consolidation in the post-pandemic period (2022–2024).

The results show more favorable perceived effects of digitization on economic and social sustainability, particularly in terms of market reach, operational efficiency, digital skills, and customer relationships, while the perceived effects on environmental sustainability remain more limited and largely indirect.

This pattern confirms that the adoption of digital tools, while necessary for business continuity, does not in itself guarantee a profound or sustainable transformation, as its scope is constrained by persistent structural barriers, particularly in training, financing, and connectivity.

The evidence shows that the digital transformation of microenterprises in Quevedo is in a phase of partial consolidation, in which technology primarily serves to facilitate adaptation, ensure operational continuity, and improve efficiency. However, limitations persist in achieving a more strategic integration of digital tools into organizational processes and the various dimensions of business sustainability.

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