Review

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Mapping the Intersection of Entrepreneurship, Digitalization, and the SDGs: A Scopus-Based Literature Review

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Abstract

This study examines the dynamic interconnection between entrepreneurship, digital transformation, and the Sustainable Development Goals (SDGs), placing the research question in a broader socio-technological context. The research was based on a systematic review of 22 empirical studies drawn from the Scopus database and related to technological innovations adopted by business initiatives aimed at sustainable development. Through thematic analysis, the dominant technologies (such as artificial intelligence, blockchain, ERP systems, digital platforms, and ESG data analysis) were identified, as well as the methodological approaches followed in the relevant international literature. The main findings indicate that digital transformation offers significant opportunities to enhance innovation, transparency, and social inclusion. However, challenges also arise, such as digital inequalities, the lack of a strategy for alignment with the SDGs, and institutional weaknesses. In conclusion, the transition to sustainable digital business models requires a multidisciplinary approach, strengthened leadership, educational interventions, and institutional support. This study contributes theoretically and practically to the ongoing scientific dialogue on sustainable and digitally supported entrepreneurship.

Keywords: digital transformation; sustainable development goals (SDGs); digital entrepreneurship; innovation; artificial intelligence; social entrepreneurship; blockchain; literature review

1. Introduction

There is a global need to meet Sustainable Development Goals (SDGs) and rapidly adopt digital technologies in almost every sector. In this changing environment, entrepreneurship plays a crucial role in promoting innovation and supporting sustainable development strategies and initiatives. Many researchers [1,2] support the idea that digital transformation has changed how businesses operate and boosted the development of new models that integrate social and environmental values with economic growth. Digital transformation, also known as digital reform, is a significant organizational and strategic shift that impacts all facets of business processes and ecosystems rather than being a technical or technological improvement. New technologies like artificial intelligence, big data, the Internet of Things (IoT), and many others, have created new opportunities for promoting sustainable business initiatives, while they have also brought challenges such as digital inequality and social exclusion [3].

The United Nations 2030 Agenda for Sustainable Development requires innovative business ideas that meet the 17 SDGs. The adoption of digital technologies within organizations can support goals such as decent work and economic growth (SDG 8), industrial innovation and better infrastructure (SDG 9), while they can also minimize inequalities (SDG 10), and promote climate friendly actions (SDG 13).Using digital tools builds resilience, especially during rough circumstances like the Covid-19 pandemic [4-6]. Switching from analog to digital has become a significant part for a company's survival, competitiveness, and growth [7]. Digitalization is crucial not only for

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sustainable development but also for generating social and environmental benefits [8]. The smart combination of digital innovations with mixed business models gives certain social enterprises a competitive edge, helping them push economic progress while also making a positive social mark [7].

Sustainability is a key skill that comes from using digital platforms and technology in entrepreneurship to address global issues with sustainable development [9]. As will be further explained, sustainability is an unquestionably broad and pervasive phrase that has been extremely popular in scientific discourse because of its appearance in several official governmental documents and scientific publications. In the context of entrepreneurship, sustainability is seen more broadly and refers to the strategic assessment and management of institutions and organizations at all levels that are cognizant of environmental, social, and financial concerns as well as their efforts to provide sustainable solutions [10,11].

Digitalization and contemporary technology developments have drastically altered the entrepreneurial landscape and opened up new avenues for starting and running a firm in ways other than conventional ones. New market areas, goods, distribution routes, and consumer communication have all emerged. Scholars interested in new types of entrepreneurship have not overlooked this. The terms "internet entrepreneurship," "cyber-entrepreneurship," "e-entrepreneurship," "web entrepreneurship," "information entrepreneurship," "online entrepreneurship," and "digital entrepreneurship" have become popular [12]. While some authors view these terms as distinct types of entrepreneurship, others consider them subsets of digital entrepreneurship. Technology propels economic development and progress and makes it possible to create new employment and enterprises, some of which are fully digital (SDG8). Additionally, it helps reduce inequality (SDG 10) and create sustainable cities and communities (SDG 11). Building robust and sustainable infrastructure is facilitated by innovation, ICT infrastructure, and digital transformation of businesses (SDG9). It is important to highlight the interdependence and relationship between the objectives of sustainable development. Simultaneously, the examination of entrepreneurship's contribution to the SDGs depends on its typology based on the level of digitalization.

However, despite the growing importance of this interconnection, the relevant literature is fragmented and lacks a comprehensive understanding of the mechanisms through which entrepreneurship and digital transformation combine to promote sustainability. Specifically, Figure 1 shows that the research interest on this field started to increase since the last 6 years.

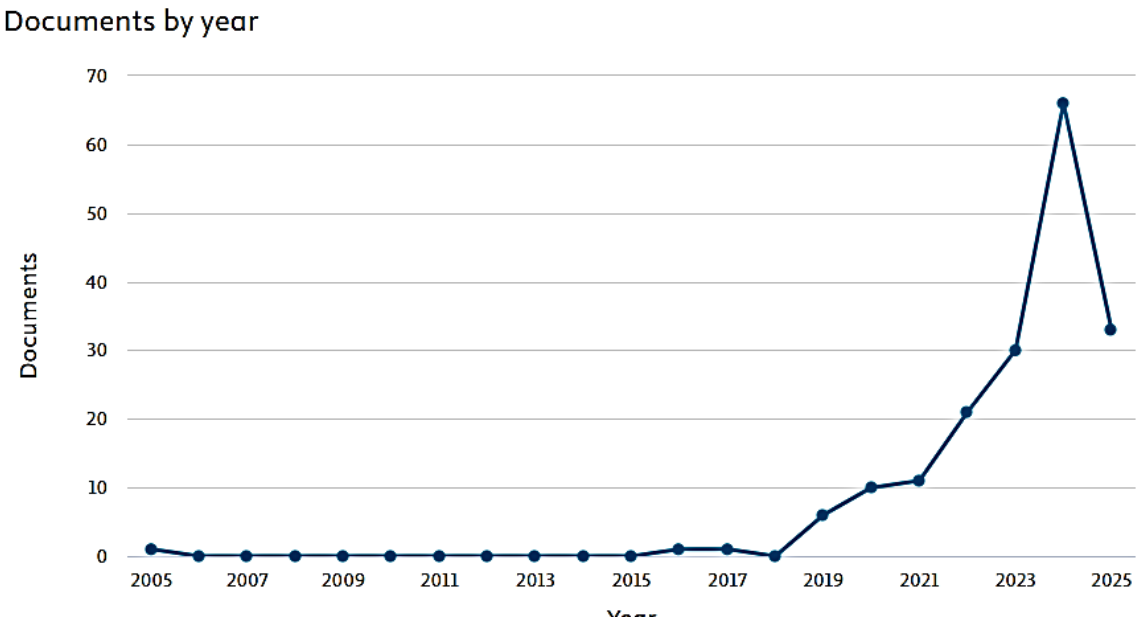

Figure 1. Research on the interconnection among digital technologies, SDGs and entrepreneurship (Source: Scopus database).

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Most studies either focus individually on the impact of technology on business innovation or analyze the contribution of entrepreneurship to sustainability without examining in depth the complex and interdependent network of relationships that develops between these three critical dimensions, proactiveness [13,14]. A systematic and descriptive review of existing scientific knowledge is urgently needed. By synthesizing recent research findings recorded in high-quality scientific sources (such as the Scopus database), this study attempts to map the research landscape, highlight trends and approaches, identify gaps in the literature, and formulate proposals for future research. Figure 1 shows that only 40 documents published from 2019 to 2025 discuss the interconnection among SDGs, digital technologies, and entrepreneurship, while there has been a notable increase in research interest in this issue over the last year. This supports the argument that the present field is completely new and innovative in research and that there is a strong need to conduct more studies.

Based on the above considerations and findings, the main purpose of this study is to explore the connection and interaction between entrepreneurship, digital transformation, and Sustainable Development Goals. Through a review of existing research in the context of a descriptive literature review, an attempt is also made to explore the use of technological innovations that are exploited commercially to achieve the SDGs, as well as the challenges and opportunities that emerge in the implementation of digital strategies in sustainable business initiatives. To achieve the above, the study formulates and answers the following three research questions:

RQ1: What primary research methods have been used to study the intersection of entrepreneurship, digital transformation, and sustainable development goals (SDGs)?

RQ2: Which digital technologies are driving entrepreneurial initiatives that contribute to the SDGs?

RQ3: What opportunities and challenges emerge for entrepreneurs using digital transformation to advance sustainable development goals?

The answers to these questions are expected to provide important theoretical and practical contributions to the field of entrepreneurship and sustainable digital innovation, strengthening the scientific and professional dialogue for the creation of a more resilient, digital, and sustainable future.

This study makes a substantial contribution to the existing literature, as it is one of the first attempts to map the relationship between entrepreneurship, digital transformation, and the achievement of the Sustainable Development Goals through a descriptive analysis of scientific publications at the international level. Unlike previous fragmented approaches that examine individual aspects of the topic (such as digital transformation or green entrepreneurship independently), this paper adopts a holistic perspective, highlighting the points of interaction and the endogenous dynamics that develop between the three fields. It also innovates in its use of recent scientific data from the Scopus database, thus ensuring the timeliness and scientific validity of its conclusions. The contribution of the research is twofold: on the one hand, it strengthens the theoretical background around the concept of sustainable digital entrepreneurship, proposing new ways of understanding the relationship between technological and social innovation. On the other hand, it offers practical guidance for policymakers, academics, and entrepreneurs, highlighting critical areas for technological intervention and obstacles that require institutional and strategic overcoming. By identifying research gaps and trends, the study contributes to the development of new research agendas and the promotion of sustainable and innovative business practices at a global level.

The structure of this paper is organized as follows: Section 2 presents the theoretical background of the study. Section 3 outlines the rationale of the study, and then section 4 describes the methodological approach followed for data collection and analysis. Section 5 presents the results of the analysis, while Section 6 discusses the findings in relation to the international literature. Section 7 presents the limitations of the research and suggests directions for future research. Finally, Section 8 summarizes the main conclusions of the study and highlights the importance of promoting digitally supported, sustainable business practices for achieving the Sustainable Development Goals.

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2. Theoretical Underpinnings

2.1. Entrepreneurship and Sustainable Development

Research indicates two seemingly unrelated business trends are merging, which have consequences for the philosophy and practice of entrepreneurship. First, sustainability issues have drawn increased attention, with a focus on the need for social actors to contribute more to the advancement of environmental and social values [15]. To raise public awareness, prominent media platforms like Netflix and David Attenborough's "Our Planet" series, as well as the European Parliament, which proclaimed a climate emergency, have highlighted the need for sustainable behaviors [16]. In the realm of business, the so-called "social entrepreneurs" are committed to achieving difficult environmental goals, among other things [17,18]. The second trend focuses on economic shifts and rapid digitalization. Opportunities are presented by the rise of new digital technologies for incumbent companies and organizations as well as potential start-ups. Examples include the quickly evolving domains of machine learning and artificial intelligence (AI/ML), which are being used by both businesses and governments. The Internet of Things (IoT) has the ability to connect billions of objects in self-sufficient communication networks, enhancing wealth and making life easier [19]. Distributed ledgers, or blockchains, are also overcoming their initial hype due to the promise of reorganizing transactions in ways that are more equitable, decentralized, transparent, efficient, and dependable [20,21]. Additionally, this is a digital necessity. The convergence of digital technology and sustainability imperatives is beginning to gain traction in the public and private sectors as well as in the field of entrepreneurship, despite the fact that this field has not yet mobilized systematic and rigorous academic research [22].

A “combination” of sustainability and entrepreneurship refers to social entrepreneurship (SE), which is now one of the most academically studied forms of non-traditional entrepreneurship [23]. The literature focuses on the use of market-based methods to address social problems and create social value through creative reconfiguration of resources [24]. The discussion extends to the nature and identity of social entrepreneurs and the definition of social value [25]. The common view of researchers on social entrepreneurs is that they are individuals who apply an entrepreneurial logic in an innovative and entrepreneurial way to improve specific segments of the population facing social issues [25], while creatively and innovatively exploiting business opportunities, prioritizing the creation of social wealth over economic wealth. Sustainable entrepreneurship (SE) is a recent addition to the study of entrepreneurship amid complex social and environmental problems [9]. Many large companies now have dedicated corporate social responsibility (CSR) departments to generate socially positive outcomes through their activities. Along these lines, [26] identify the emergence of SE in practice as an evolution in business orientation. This evolution was initially manifested by a shift in objectives from reducing environmental impacts [27] to a more transformative commitment to correcting market failures in economic, social, and environmental areas [28]. In its mature form, SE can thus link increased attention to process improvement with a triple result, balancing the production of economic, social, and ecological value by the businesses. In this context, [29] define sustainable entrepreneurs as individuals who start a new venture to serve both their personal and collective interests by addressing unmet social and environmental needs.

2.1.1. The Three Pillars of Sustainable Entrepreneurship

Sustainability focuses on the balance between the environment, society, and economy [30]. Economic sustainability, as one of the key pillars, relates to a business's ability to generate economic value in a socially and environmentally acceptable way [31]. It is based on the strategic use of resources, innovation, and resilience to risks, which enhances long-term profitability and competitiveness [32]. Barriers, such as the pressure for immediate profits or the complexity of measuring sustainability, make it difficult to implement relevant strategies. Clear indicators (ROI, resource consumption, and social impact) and open reference standards are required. Government support through incentives and regulations is also crucial. Environmental sustainability seeks to

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preserve ecosystems in the long term through the responsible use of natural resources. Companies must integrate practices that reduce emissions, save energy, and promote a circular economy [33]. Challenges such as climate change and a lack of financial resources require interdisciplinary cooperation. Simultaneously, regulatory compliance, efficiency, and improved corporate image are key benefits. ISO 14001 standards and Environmental Management Systems (EMS) contribute to a systematic approach to environmental management [34]. Finally, the social pillar refers to the relationships, values, and behaviors of businesses, employees, and society [34]. This includes the promotion of justice, human rights, and ethical work [35].

At this point, social sustainability is based on actions such as fair pay, local community involvement and elimination of discrimination. Companies that invest in human capital attract talent and enhance their reputations. These initiatives help create more inclusive and resilient communities [36]. Entrepreneurship is essential to the shift to a more sustainable future because of the important role that businesses play in society and the effects that their operations have. It is linked to both economic and non-economic activities that lead to the production of jobs and improved goods and services that are in high demand by societies throughout the world. As a result, entrepreneurship has a huge impact that may be used to help bring about a shift toward sustainability. Sustainable enterprises concentrate on balancing the social, economic, and ecological goals, whereas traditional business fosters economic development [30].

2.1.2. Sustainable Development Goals and Entrepreneurship

The Sustainable Development Goals (SDGs) are global frameworks for action until 2030 that aim to address social, environmental, and economic challenges. Entrepreneurship promotes the achievement of these goals by enhancing innovation, reducing poverty, and promoting social inclusion [30]. Despite the existed obstacles, mainly due to economic constraints and a lack of knowledge and skills, cooperation between actors, legislative support, and the strengthening of innovation ecosystems are necessary to promote sustainable entrepreneurship. Modern entrepreneurial strategy is shifting from exclusive profit to the creation of shared value for all stakeholders [32]. Business strategies include pollution reduction, sustainable development, and product life cycle management [33], as well as the creation of common value, thus creating a sustainable and inclusive economic environment. The main aspect of sustainable entrepreneurship is resource management that promotes well-being and reduces negative impacts on the environment. Therefore, companies must conduct their activities in an environmentally friendly, socially responsible, and commercially viable manner [34]. Sustainable entrepreneurship is the foundation for addressing today's global problems and ensuring the long-term success of a company, especially in the current period where social injustice, resource depletion, and climate change are major problems. In summary, reducing risks and enhancing growth prospects through sustainable business practices can lead to long-term economic and social prosperity as well as long-term profitability for businesses [35].

2.2. Linking Entrepreneurship, Digitalization, and the SDGs

Previous research has focused on providing a conceptual framework and conducting a thorough literature review to understand the relationship between artificial intelligence and entrepreneurship. According to [36], an executive who uses artificial intelligence can leverage data to explore new opportunities and risks, freeing themselves to focus on decisions that affect overall strategy and direction. [37] proposed a conceptual framework demonstrating how artificial intelligence systems can improve business decision-making and provided guidelines for the appropriate application of artificial intelligence as an emerging technology. There has been a serious lack of empirical studies on the impact of artificial intelligence on the business process, especially in sustainable entrepreneurship. A recent study by [38] in China, found a strong positive correlation between artificial intelligence and business activity. Specifically, this study showed that artificial intelligence promotes technological innovation and increases consumer demand, which benefits business activity

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[38]. [39] claimed that integrating digitalization and sustainable development may increase the ability of businesses to satisfy present and future demands more effectively and consistently.

These methods seek to enhance resource allocation and waste management for companies, as well as efficiency, productivity, and quality [40]. Additionally, green entrepreneurship may increase small and medium-sized enterprises' (SMEs') market recognition, attract new clients, and fortify their competitive edge. However, automation and digitalization improve accuracy, convenience, and efficiency while lowering the cost per unit. The goal of promoting and funding digital technologies is to guarantee the highest food safety level. Digital technology is an excellent substitute for improving sustainability [41]. Particularly in 2022–2024, when it will have a dominant position, sustainability has emerged as a transversal axis of social entrepreneurship. Hybrid models that combine environmental responsibility, financial sustainability, and social impact are the result of the convergence of corporate and social sector activities. Digital transformation has transformed social entrepreneurship, making procedures for organizational efficiency, scalability, and measurement easier [42]. This tendency was intensified by the pandemic from 2019 to 2021, which solidified the role of digital technology as an essential instrument for addressing societal issues. Digital platforms, artificial intelligence, and big data have not only enhanced administration but have also increased the scope and potential of social projects. [43] introduced a novel word "Technopreneurship." to describe the interconnection between entrepreneurship and technology. The United Nations [44] mentioned that innovation and entrepreneurship are important forces behind sustainable development, tackling the economic, social, and environmental facets of sustainability within the framework of the 2030 agenda. Researchers who have focused on the economic and social aspects of sustainability have highlighted the role of entrepreneurship in sustainable development, concluding that entrepreneurship is undoubtedly a key component of wealth creation [45], promoting economic growth, creating jobs, reducing unemployment and poverty, and improving the standard of living and well-being of citizens [46].Furthermore, empirical research shows that to have a positive impact on sustainable development, a high degree of quality entrepreneurship—that is, entrepreneurship that is innovative, productive, and opportunity-driven — is more significant than a high quantity of entrepreneurship [47,48].

A research gap has been identified regarding the holistic approach to the simultaneous role of entrepreneurial activity that could address all three challenges, despite the fact that the literature on entrepreneurship has increasingly acknowledged it as an effective solution to various social, economic, and environmental challenges of sustainable development [48]. The relationship between digitalization and sustainability has been the subject of numerous studies [49], which have acknowledged that although sustainability is necessary for responsible digital transformation, digitalization can be the most effective means of addressing societal issues and bridging research gaps [49]. According to [50], the interplay between digital technologies, platforms, and infrastructures and its impact on value creation has drastically changed entrepreneurship during the past ten years. The same empirical analysis shown that, between 2009 and 2015, technology-driven entrepreneurship in European nations was positively impacted by technology readiness criteria, such as ICT investment and corporate ICT usage.

Owing to the impact of digitalization on the economy and society, entrepreneurship has undergone tremendous change in the past ten years against the backdrop of the Fourth Industrial Revolution [50]. Thus, in recent years, both theoretical and empirical studies have focused more on digital entrepreneurship, which the European Commission claims has used new digital technologies to influence new enterprises and mold existing ones [51]. Digital entrepreneurship is the product of the intersection of digital technology and entrepreneurship, given that new digital technologies have changed entrepreneurial processes and outcomes. [51] state that digital entrepreneurship as a term has not yet been defined precisely.

A number of SDGs, including SDG 1 ("End poverty in all its forms everywhere"), SDG 8 ("Promote inclusive and sustainable economic growth, employment, and decent work for all"), and SDG 10 ("Reduce inequality within and among countries"), are largely influenced by entrepreneurial

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activity, according to the Global Entrepreneurship Monitor Report [47]. Furthermore, the United Nations [52] acknowledges that entrepreneurship is essential for fulfilling all three SD characteristics. Accordingly, the UN [52] has recognized innovation and entrepreneurship as crucial forces behind maximizing a country's economic potential to achieve the SDGs. The UN states that entrepreneurship contributes to the economic aspect of sustainability by generating employment and economic growth, which, in turn, promotes innovation and decent work. Regarding the social aspect of sustainability, it has been acknowledged that entrepreneurship may provide possibilities for everyone, promote social cohesion, and lessen inequality. The UN also accepts the role of entrepreneurship in the environmental dimension, emphasizing that entrepreneurship can address environmental issues by encouraging sustainable practices and eco-friendly consumption patterns, as well as by pushing for the adoption of innovative digital technologies and resilience policies [52].

However, although several empirical studies have explored the role of digital technologies and entrepreneurship in achieving sustainable development, there is a lack of research on the effects of digital entrepreneurship on the SDGs.

3. The Rationale of the Study

It becomes clear that the global community is characterized by rapid changes and developments that accelerate the need for systemic transformation, both in the digital sector and in the field of sustainability, while emphasizing entrepreneurship as a key pillar of a country's economy. In this context, entrepreneurship is emerging as a key mechanism for innovative solutions to social, environmental, and economic challenges, mainly through the strategic use of digital technologies aligned with the Sustainable Development Goals (SDGs). Although the transformative impact of digital technologies on business models has been widely recognized [53] and the contribution of entrepreneurship to sustainable development has only emerged in recent years [9, 10], the relationship between these fields remains unexplored. The convergence of the concepts of “entrepreneurship,” “digital transformation,” and “sustainability” as three contemporary, and dynamic fields is still in its infancy.

Furthermore, despite the fact that studies have been conducted on either the impact of digitalization on entrepreneurship and innovation or the contribution of (social) entrepreneurship to sustainable development, there is still a research gap and a lack of systematic and comprehensive analysis of the link between these concepts [7]. This study attempts to fill this research gap through a descriptive literature review, proposing a descriptive and theoretically grounded mapping of the existing literature. By synthesizing recent findings from published research in the Scopus database, this study aims to highlight research trends, identify gaps, and formulate recommendations for future research directions. The necessity of this study is therefore twofold: on the one hand, to strengthen the theoretical background surrounding the link between digital transformation, entrepreneurship, and sustainable development, and on the other hand, to offer practical guidance for policymakers, academics, and entrepreneurs, pointing out critical areas for technological intervention and institutional barriers that need to be overcome.

In this way, this paper contributes both to the advancement of scientific knowledge and to the promotion of sustainable and innovative business practices at a global level. The research questions to be addressed are:

- RQ1: What primary research methods have been used to study the intersection of entrepreneurship, digital transformation, and sustainable development goals (SDGs)?
- RQ2: Which digital technologies are driving entrepreneurial initiatives that contribute to the SDGs?
- RQ3: What opportunities and challenges emerge for entrepreneurs using digital transformation to advance sustainable development goals?

4. Materials and Methods

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Using the Scopus database, a review of scholarly studies published from 2005 to 2025 was done. Reviews highlight current state-of-the-art research, offer a thorough discussion, critically assess various methodological methods, and even suggest future research goals. They are essential for synthesizing previously published work under a particular theme. (1) search strategy, (2) selection, (3) quality evaluation, (4) data extraction, and (5) data synthesis were the processes that were carried out in the current study. The Scopus database provides extensive coverage of scientific sources, according to several studies [21, 54, 55]. In comparison with other respectful databases, [56] mentioned that Scopus offered more thorough coverage of the literature than WoS. Additionally, they discovered that a greater number of publications and conference proceedings were indexed by Scopus, which raised the possibility of discovering pertinent papers. The present research conducted a descriptive literature review to identify research literature focusing on the relationship between entrepreneurship, digital transformation, and sustainability. The authors chose SCOPUS database taking into consideration the above mentioned advantages. The following Table (Table 1) presents the Boolean expressions with the main key terms and keywords used for the research.

Table 1. Key terms, keywords, and Boolean expressions.

TITLE-ABS-KEY (entrepreneurship OR entrepreneurial) AND digital AND (transformation OR technologies) AND (sustainability OR sustainable development OR goals) AND (LIMIT-TO (EXACTKEYWORD, "Sustainable Development" OR "Entrepreneurship*" OR "Digital Transformation" OR "Digital Technologies" OR "Sustainability*" OR "Circular Economy" OR "Digital Innovation" OR "Artificial Intelligence" OR "Social Entrepreneurship*" OR "SMEs" OR "Digital Skills" OR "SDGs" OR "Digital Business") AND (LIMIT-TO (LANGUAGE, "English") AND (LIMIT-TO (DOCTYPE, "ar")

Source: Authors' contribution through Scopus database research.

To conduct the review, a combination of Boolean operators was used to identify a targeted and thematically relevant body of literature. Specifically, the AND operator was used to limit the results to records that included multiple thematic concepts simultaneously (e.g., entrepreneurship AND digital transformation AND sustainability), ensuring high thematic relevance. The OR operator was used to broaden the search scope with synonymous or complementary keywords (e.g., sustainability OR sustainable development goals). All terms were incorporated into a strictly structured search strategy (see Table 1), which incorporated concepts related to entrepreneurship, digital transformation, and sustainable development, such as digital technologies, SDGs, circular economy, digital innovation, sustainable entrepreneurship, SMEs, and artificial intelligence. Simultaneously, specialized search restriction filters were applied, such as LIMIT-TO (LANGUAGE, English) to exclude non-English entries, LIMIT-TO (DOCTYPE, "ar") to select only articles published in scientific journals, and LIMIT-TO (EXACTKEYWORDS) with some of the most relevant thematic keywords, based on Scopus Thesaurus (for example "Entrepreneurship," "Sustainable Development," "Digital Transformation," "Digital Skills," "Social Entrepreneurship," "Digital Business," "Environmental Sustainability"). Finally, the use of the asterisk (*) as a wildcard, was chosen in some cases (e.g., sustainab or entrepreneur) to include different grammatical variations and morphological derivatives of the terms, accurately broadening the results without losing the focus. Table 2 below presents the main key-words (EXACT KEYWORDS), organized in specific categories in the way they used from the authors at Boolean query of the systematic review.

Table 2. The exact keywords used in the study.

Category	EXACT KEYWORD
Entrepreneurship	Entrepreneurship
	Entrepreneur
	Entrepreneurial Orientation

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Social Entrepreneurship	Social Entrepreneurship
Digital Technologies	Digital Transformation Digital Technologies Digitalization Digital Skills Digital Business
Sustainability	Sustainable Development Sustainable Development Goals Sustainability Environmental Sustainability
Innovation	Digital Innovation Technology Innovation Open Innovation

Source: Authors' contribution.

The PRISMA 2020 statement was used to develop the protocol [57]. 314 papers from the SCOPUS database were found in the first search, as can be seen in the PRISMA flow diagram (Figure 2). The dataset was first cleaned up by removing duplicate entries (n = 134), then 180 articles were examined for eligibility. During the screening phase, 23 publications were removed for a variety of reasons, including duplicates (n=4), abstracts (n=12) that lacked any of the primary keywords of the current study (entrepreneurship, SDGs and digitalization, or digital technologies), and unrelated titles (n=7). Due to inadequate data, 77 of the 157 items that were requested could not be obtained. After then, eligibility was assessed for 80 articles.

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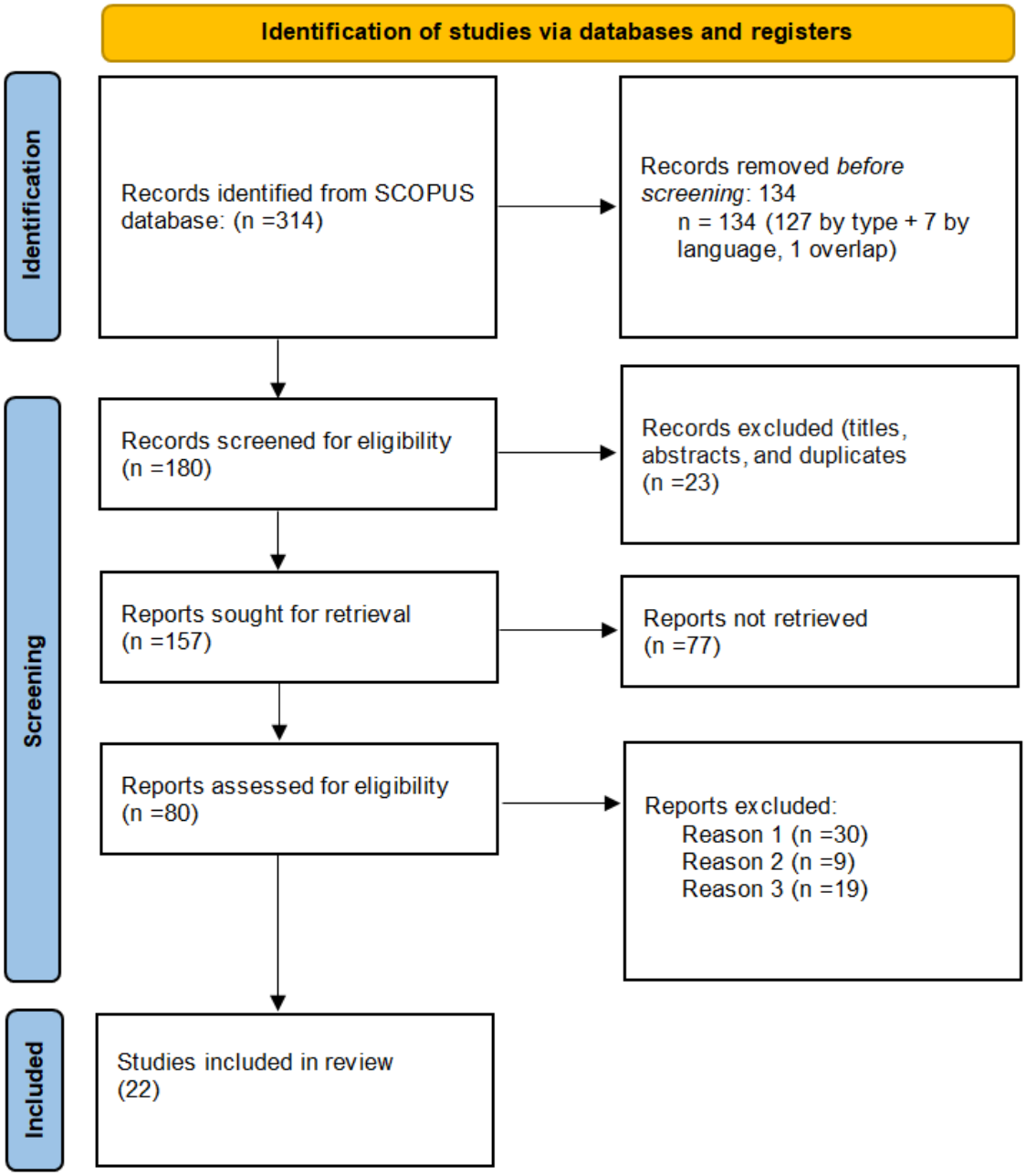

Figure 2. PRISMA Diagram visualizing the selection process of study (Source: Authors' contribution).

In the next stage, the 80 articles proceeded to the final evaluation, using predefined inclusion and exclusion criteria which will be analyzed in more detail below (e.g. presence of empirical data, connection with digital entrepreneurship and sustainability). Thirty articles that were theoretical analyses or literature reviews were excluded, as were nine articles that did not meet the language/typology criteria (Chinese-5, Spanish-3, Russian-1), and nineteen articles due to inaccessibility. Finally, 22 articles were included in the review. The thematic analysis that followed was based on characteristics such as geographical distribution, research methodology, assessment tools, educational levels, and specific aspects of entrepreneurship highlighted through digital technologies in the context of the Sustainable Development Goals. The articles were evaluated in three successive stages: cleaning, full-text identification, and final evaluation based on research relevance. Table 3 summarizes the inclusion and exclusion criteria for the present study.

Table 3. Inclusion and Exclusion criteria.

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Inclusion criteria	Exclusion criteria
Articles published in English	Non-English publications (Chinese 5, Spanish 3, Russian 1)
Articles published in scientific journals (type: article)	Press articles: conferences, books, letters, editorials (Conference paper- 73, Book chapter-29, Review-21, Book-2, Letter-1, Editorial- 1)
Studies with empirical data or methodological documentation	Reviews/theoretical articles without primary data
Focus on entrepreneurship and digital technologies	Lack of relevance to the thematic area
Link to sustainable development or SDGs	Lack of clear reference to sustainability or digital tools

Source: Authors' contribution.

To complete the methodology process, the authors implemented a thematic analysis of 22 selected articles. Thematic analysis aims to interpret the main approaches, research objectives, applications, and impacts of digital technologies in the field of entrepreneurship and sustainable development [58]. Each study was read multiple times by the researchers, who kept independent notes to ensure a proper understanding of the content, methodology, procedures, and findings. The individual analyses were compared and discussed in groups until consensus was reached on interpretations and thematic categorization. In the next stage, the quality of the studies was assessed in relation to the research questions of the review. In particular, emphasis was placed on the ability of the articles to address issues such as: The role of digital technologies in strengthening entrepreneurship as well as Strategies and practices that link innovation and entrepreneurship to the Sustainable Development Goals (SDGs). Only studies that provided clear empirical or applied data and were linked to practices or approaches relevant to sustainable and digital entrepreneurship. The analysis aims to synthesize an interpretative framework that highlights the intersection of digital innovation, entrepreneurship, and sustainability. The thematic analysis focused on interpreting how digital technologies support entrepreneurship and social entrepreneurship as well as sustainability. Finally, the studies were selected on the basis of clearly defined inclusion and exclusion criteria. The authors declare no bias or selectivity as the origin of the articles (although predominantly European) is the result of the methodological process and not of deliberate selection.

4. Results

RQ1: What primary research methods have been used to study the intersection of entrepreneurship, digital transformation, and sustainable development goals (SDGs)?

From the analysis of the articles, five basic categories of methodological approaches can be distinguished and presented in Table 5:

Table 5. The main categories of methodological approaches.

Research Method	Description/Implementation
Descriptive Case Studies	Analyses of empirical examples (e.g., non-profit organizations, social enterprises, startups) to understand the application of digital transformation to the SDGs.
Qualitative Methods	Use of semi-structured interviews, thematic analysis, grounded theory, especially for social/human dimensions of entrepreneurship.
Quantitative Methods	Use of questionnaires, statistical data (e.g., Rosstat, Scopus, ESG indicators) to measure correlations and comparisons between regions or groups.

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Mixed Methods	Combination of questionnaires and interviews or case study approaches for richer data.
Bibliometric / Systematic Review	Studies that map the research field based on scientific databases (Scopus, Web of Science), using tools such as VOSviewer or PRISMA.

Source: Authors' contribution.

As mentioned before, the research sample consists of 22 studies with empirical data. Twenty-one articles that were theoretical analyses or literature reviews were excluded. This literature review was based on a final sample of 22 empirical studies, following the exclusion of theoretical analyses and literature reviews according to the PRISMA framework criteria. The scientific approach to studying the intersection between entrepreneurship, digital transformation, and the Sustainable Development Goals (SDGs) has recorded remarkable methodological diversity, reflecting the interdisciplinary and multifactorial nature of the field. However, a systematic review of the available literature clearly shows that quantitative empirical methods dominate, accounting for approximately 60% of all research, followed by qualitative studies and mixed methods (25%) and mixed methods (15%).

The dominance of quantitative methods is reflected in studies that seek to quantitatively measure the impact of technologies such as blockchain, artificial intelligence, and digital business models on efficiency, innovation, and sustainability. For example, the work of [59] uses the Data Envelopment Analysis (DEA) method, a sophisticated efficiency measurement tool, to assess the impact of the adoption of FinTech and Blockchain technologies on business performance in terms of ESG (Environmental, Social, Governance) and DEI (Diversity, Equity, Inclusion) criteria. The analysis was based on data from 50 companies from 2017 to 2023, with multidimensional inputs and outputs, offering quantitatively substantiated conclusions on the performance of companies in the context of sustainable entrepreneurship. A similar quantitative approach is adopted by [60], who, based on data from the Global Entrepreneurship Monitor, analyzed trends in digital and sustainable entrepreneurship in 47 countries using multivariate regressions and demographic variables, highlighting the strategic importance of digital technologies in shaping environmentally and socially sensitive business models. The same approach is found in the study by [61], which examined the relationship between the use of ERP systems, the perception of cultural distances, and environmental sensitivity with the internationalization intentions of small and medium-sized enterprises, through the processing of questionnaire data from 315 companies. Quantitative analysis is also adopted in the study by [62], which was based on a questionnaire of 320 start-ups in Berlin and showed that despite increasing digitalisation, most start-ups are primarily focused on economic efficiency, downplaying social and environmental goals. This finding demonstrates the usefulness of quantitative tools in capturing priorities and behaviors in a real business environment.

At the same time, a significant number of studies rely on qualitative methods, mainly to analyze concepts such as resilience, emotions, leadership skills, and the social impacts of digital transformation. The study by [63] applies qualitative longitudinal analysis, focusing on the psychological and social resilience of Saudi Arabian women entrepreneurs during the pandemic. The findings show that emotional connection to entrepreneurial activity was a critical factor for survival in times of crisis. Similarly, in the study by [64], a case study of the Felix Project charity in London confirms the importance of entrepreneurship and leadership in the digital transition of socially oriented organizations. A more comprehensive approach is proposed by [65], who use an exploratory sequential mixed method, combining qualitative interviews and quantitative questionnaires. They focus on the opportunities and inequalities created by digitization in the rural business sector, emphasizing the importance of local knowledge and social solidarity as components of sustainable development.

In summary, the analysis of the sources shows that quantitative empirical methodology is the dominant research approach, covering approximately 60% of the studies, as it allows for accurate

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measurement of returns, document causal relationships, and formulate data-driven policy proposals. This is followed by qualitative and mixed methods, accounting for around 25%, which offer an in-depth understanding of subjective experiences and organizational behavior, and finally, mixed methods, which account for approximately 15%, mainly serving as frameworks for conceptual mapping and the formulation of research programs. This comparative picture demonstrates the importance of integrating quantitative and qualitative approaches for a more complete understanding of a complex, cross-cutting field such as entrepreneurship in the digital and sustainable era.

RQ2: Which digital technologies are driving entrepreneurial initiatives that contribute to the SDGs?

The contribution of digital technologies to shaping a new business landscape linked to the Sustainable Development Goals (SDGs) has been the subject of intensive study in recent years. As evidenced by the research material examined, technologies such as artificial intelligence (AI), blockchain, big data analytics, ERP systems, cloud computing, digital platformization, automated ESG data analysis, the Internet of Things (IoT) and digital innovation management are the main technologies supporting business activities that are aligned with the SDGs.

Artificial intelligence (AI) is examined centrally in the work of [66], where it emerges as a strategic catalyst for coupling digital and sustainable transformation. Through AI patents related to the SDGs, the potential of this technology for sustainable innovation, resource management, and waste reduction is highlighted. At the same time, in the work of [60], the strategic use of digital technology in sales and decision-making was found to increase the inclusion of social and environmental criteria in business strategy. Blockchain technology occupies a particularly important place in the research approach of [59]. Using Data Envelopment Analysis (DEA), their study shows that the adoption of blockchain increases the effectiveness of companies in ESG and DEI goals, mainly through enhanced transparency, data security, and process reliability. Blockchain is linked to SDGs 9, 12, and 16. Big Data Analytics and digital utilization of ESG data are analyzed by [67], who point out that big data makes it possible to measure social and environmental impact. The interoperability of these technologies enhances decision-making in organizations that adopt SDGs as a key strategic focus. Enterprise Resource Planning (ERP) systems are presented in the study by [61] as digital tools that enhance sustainability through better management of business resources and facilitate compliance with international standards. These are related to enhancing efficiency in regions of Central and Eastern Europe. The digital platform and e-entrepreneurship are highlighted in the work of [65], who examine how these technologies empower rural business initiatives and local communities. Digital transformation, especially when combined with local knowledge and social entrepreneurship, contributes to SDGs 1, 8, and 10. Cloud computing is mentioned by [49] in relation to "digital readiness." Cloud infrastructure is the basis for scaling up digital business models, especially in organizations seeking innovation with a low environmental footprint.

The importance of digital leadership and governance is highlighted in the work of [68], which concerns the digital transformation of a non-profit organization in London. The integration of digital technologies enabled resource optimization and the achievement of SDG 2 on zero hunger. [69], identify digital transformation, innovation, and digital business models as key technologies, classifying them into three themes: "innovation and entrepreneurship," "transformation strategy," and "SDGs." The research by [70] documents how the adoption of digital tools in the global business arena leads to more effective marketing strategies and enhances sustainability through automation, digital communication, and improved customer management. Also noteworthy is the finding by [71], who argue that regional business ecosystem policies should strengthen digital interconnections and technological knowledge-sharing capabilities as key drivers of innovation and TFP (Total Factor Productivity). [72], focusing on Russia, confirm that technological upgrading at the regional level through the digitization of business activity is critical for achieving the SDGs in environments with lagging infrastructure. In the case of [62], it is found that although many start-ups use digital tools,

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few are strategically oriented towards social or environmental goals, highlighting the need to strengthen the regulatory and institutional framework.

The study by [73] shows that digital management tools for social enterprises enhance social impact and sustainability measurement capabilities. The study by [61] finds that the use of digital export tools (e-export platforms) helps SMEs overcome cultural and geographical barriers and align with SDG 17 (Partnerships for the Goals). The research by [74] highlights how the use of digital technology in education strengthens social entrepreneurship and cultivates horizontal skills such as problem solving and teamwork, in line with SDG 4 (Quality Education). Finally, [75] argue that the Industry 5.0 framework, with its emphasis on digital education and human-centric technologies, can bridge digital divides and foster sustainable business practices in the educational ecosystem.

In conclusion, the intersection of entrepreneurship, digital innovation, and sustainability is mainly achieved through technologies such as AI, blockchain, big data, cloud computing, ERP, and digital platforms. Of the 22 studies examined, each highlights aspects of these technologies as catalysts for achieving different SDGs. However, their successful adoption depends on their alignment with the institutional and social characteristics of each ecosystem.

Table 6. The main digital technologies which affect entrepreneurial initiatives and contribute to the SDGs.

Author/s	Technology	Related SDGs
[66]	Artificial Intelligence (AI)	SDG 9, SDG 12, SDG 13
[60]	Digital technologies in sales & strategy	SDG 9, SDG 13
[59]	Blockchain	SDG 9, SDG 12, SDG 16
[57]	Big Data Analytics, ESG data systems	SDG 9, SDG 13
[61]	ERP systems, E-export platforms	SDG 8, SDG 17
[65]	Digital platforms, e-entrepreneurship	SDG 1, SDG 8, SDG 10
[49]	Cloud computing, digital readiness	SDG 9, SDG 12
[68]	Digital leadership, digital governance	SDG 2
[69]	Digital transformation, innovation, business models	SDG 8, SDG 9, SDG 12
[70]	Automation, digital communication, CRM tools	SDG 9, SDG 12
[71]	Digital interconnectivity, knowledge-sharing tech	SDG 8, SDG 9
[72]	Regional digitalization technologies	SDG 8, SDG 9
[62]	General digital tools in startups	SDG 9, SDG 12
[73]	Digital management tools (for social enterprises)	SDG 1, SDG 8, SDG 10
[74]	Digital education tools	SDG 4
[75]	Industry 5.0, human-centric digital education	SDG 4, SDG 8, SDG 9

Source: Authors' contribution.

RQ3: What opportunities and challenges emerge for entrepreneurs using digital transformation to advance sustainable development goals?

The adoption of digital transformation by businesses offers significant opportunities, but also brings multidimensional challenges when it aims to align with the Sustainable Development Goals (SDGs). As highlighted by a wealth of recent studies, technology acts both as an accelerator of sustainability and as a feedback system that is influenced by the social and institutional structures within which it operates [49, 59, 61, 65, 66, 68, 69, 70].

Digital technologies such as artificial intelligence (AI), blockchain, ERP systems, digital platforms, and cloud computing offer entrepreneurs tools that enhance transparency, reduce costs, optimize resources, and provide access to new markets. AI and big data analytics enable the prediction, measurement, and evaluation of social and environmental impacts, making ESG goals more manageable [66, 67, 69]. Blockchain offers increased traceability and transparency in business processes, strengthening consumer and institutional trust [51, 59]. ERP systems, especially for SMEs, help with compliance with international standards and accelerate sustainability through improved resource management [61]. At the same time, digital platforms and export tools enhance the

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integration of excluded regions and populations into the global market, as seen in the cases of rural entrepreneurship or the social economy [61, 65, 74]. Technology also acts as a tool for democratization and knowledge diffusion. The use of digital educational tools contributes to the development of social entrepreneurship and the cultivation of 21st-century skills [74, 75]. Managing social enterprises with digital tools enhances the ability to measure social impact [73].

Despite the above potential, the implementation of digital transformation in sustainable entrepreneurship faces significant obstacles. First, digital inequality (digital divide) continues to limit many entrepreneurs' access to advanced technologies, especially in developing regions. As pointed out by [72], the lack of infrastructure and technical skills is delaying the transition to digital and sustainable business models.

Second, the lack of a strategic alignment between technology adoption and the SDGs is a common phenomenon, especially among startups, as shown by the study by [62]. Many companies use digital tools exclusively for operational or commercial reasons, without considering their social or environmental impact. In addition, there is institutional discontinuity between national and regional policies. [71] emphasize the need for coherence between digital policy, innovation, and sustainability policy. When entrepreneurial ecosystems are fragmented, the implementation of systemic and sustainable technological solutions becomes weak. Another important challenge is the lack of digital leadership and a culture of transformation, particularly in the social sector. The study by [68] demonstrates that without appropriate leadership and organizational skills, even the adoption of technologies does not automatically lead to social or environmental benefits. Finally, many studies point to the lack of a unified theoretical and conceptual framework for linking digital technologies and SDGs. [69] identify significant ambiguity and overlap between concepts such as "digital business model," "innovation," and "sustainability," making it difficult to adopt common practices or policies at the European and international levels.

Entrepreneurs who leverage digital technologies to achieve the SDGs have at their disposal a powerful set of tools that enhance innovation, participation, efficiency, and transparency. At the same time, however, they face inequalities in access, strategic direction deficits, institutional inconsistency, and leadership gaps. Long-term success lies in institutional integration, education and empowerment of entrepreneurs, and the cultivation of digital maturity that will make sustainability a strategic orientation.

6. Discussion

This study systematically analyzed 22 empirical articles examining the link between digital transformation, entrepreneurship, and Sustainable Development Goals (SDGs), seeking to identify the prevailing technological trends, methodological directions in the literature, and the main benefits and limitations for entrepreneurs seeking to transition to sustainable digital models.

Initially, the analysis of the methodological characteristics of the studies revealed the significant presence of quantitative and mixed research designs. Questionnaires, secondary ESG indicators, regression analyses, and statistical comparisons were used in a large part of the sample [18, 61, 70]. At the same time, some studies approached the topic qualitatively, through case studies or interviews, highlighting endogenous dynamics within companies [68, 73]. The comparative focus on start-ups, small and medium-sized enterprises (SMEs), and social actors shows that the field mainly focuses on organizations operating in rapidly changing or socially sensitive ecosystems [61, 62, 65].

In terms of the digital technologies used, the picture is highly multidimensional. Technologies such as artificial intelligence (AI), blockchain, big data analytics, ERP systems, cloud computing, and digital platforms play a central role in linking innovation with sustainability. AI, according to [66] and [69] acts as an innovation accelerator and supports the strategic integration of ESG objectives into business models. Blockchain, for its part, is used to enhance transparency and responsible data recording, which is related to goals such as SDGs 12 and 16 [33, 37, 39, 59]. At the same time, studies by [67] and [70] show how the use of ESG data and automated assessment tools enhances efficiency and sustainability.

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Of particular interest is the use of technologies by social entrepreneurship organizations or educational institutions. The use of digital management tools in social enterprises facilitates the measurement of social impact and enhances accountability [73, 75]. Similarly, digital education and skills technologies empower young and disadvantaged populations [74,75], promoting goals such as equality, quality education, and human capital enhancement.

However, the implementation of digital technologies to achieve the SDGs is not without challenges. A recurring obstacle is inequality in access to digital infrastructure and skills, especially in regions with low technological maturity [23,72]. These constraints increase the risk of creating a "digital divide" that excludes small or socially vulnerable entrepreneurs from the transition to sustainable innovation. In addition, many studies point to the lack of regulatory frameworks on data security, privacy protection, and the interoperability of public digital services [1].

Added to this is the challenge of strategic alignment: many entrepreneurs, especially in the start-up sector, are exploiting digital technologies without linking them meaningfully to the SDGs [37,50,62]. The absence of long-term planning, appropriate training, and institutional support leads to fragmented and unsustainable applications.

Finally, the need for interdisciplinary approaches, political support, and enhanced learning emerges as a critical factor for the long-term success of the endeavor. The contribution of education, local policies, and organizational leadership to building resilient and socially sensitive business ecosystems is highlighted by many researchers [5,12,48].

7. Limitations and Future Research Directions

This literature review attempted to fill a significant gap in the international literature by examining the contribution of digital transformation to entrepreneurship aimed at achieving the Sustainable Development Goals (SDGs). Emphasis was placed on analyzing empirical research published over the last five years, with the aim of identifying the methodologies, technologies, applications, and challenges identified in the emerging ecosystem of sustainability-oriented digital entrepreneurship.

However, the review is subject to certain limitations. First, although the search included many academic databases (e.g., Scopus, Web of Science, Google Scholar), relevant studies published in less accessible sources, grey literature or languages other than English may have been omitted. Second, the exclusive focus on empirical studies led to the exclusion of theoretical models that could enrich the theoretical foundation of the field. Third, no quantitative meta-analysis of the results was performed, which limits the possibility of generalizable comparisons.

Taking the above into account, a number of avenues for future research are proposed:

- Development of interdisciplinary models: It is proposed to develop theoretical frameworks that integrate knowledge from fields such as entrepreneurship, sustainability studies, technology, and social innovation. An example could be the integration of "Triple Bottom Line" models with digital strategy frameworks.
- Expansion to underrepresented areas: Most of the research reviewed focuses on Europe, North America, and certain parts of Asia. However, there is a lack of empirical analysis from regions such as sub-Saharan Africa, Latin America, and the Arab world. Enhancing geographical diversity would strengthen understanding of inequalities and local specificities.
- Promoting mixed methodological approaches: Despite their importance, mixed methods appear to a limited extent in the sample. Future research could focus on combined approaches that link quantitative performance data with qualitative interpretations of business strategy choices.
- Assessing the social impact of technologies: Few studies accurately measure the social and environmental impact of digital technology adoption. Research projects using ESG assessment indicators, life cycle analysis (LCA), or impact modeling are recommended.
- Strengthening action research: The application of interventionist approaches in businesses or social organizations in real time can yield important practical knowledge for the transition to digital and sustainable models.

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- Education and capacity building: Future literature could focus on educational interventions and training programs for digitally oriented sustainable entrepreneurship, as well as on measuring their effectiveness.
- Critical exploration of "digital assumptions": Research frameworks can critically examine assumptions about technological determinism or automatic progress through technology, highlighting potential social exclusion or negative externalities

8. Concluding Remarks

This literature review highlighted the important, but still evolving, contribution of digital transformation to sustainable entrepreneurship. The mapping of 22 empirical studies revealed a variety of methodological approaches, technological applications, and strategies adopted by entrepreneurs in different geographical and institutional contexts to achieve the SDGs.

One of the main conclusions is that digitization is not a guarantee of success, but a dynamic tool whose exploitation requires appropriate skills, a regulatory framework, institutional support, and social awareness. The development of sustainable and innovative business models requires a combination of technological competence, social mission, and ethical responsibility. Furthermore, the convergence of digital technology and sustainable values can lead to new examples of business action that strengthen social cohesion and environmental awareness.

An additional element that reinforces the findings of this literature review concerns the thematic representation of research output through bibliometric mapping using the VOSviewer tool (Figure 3). Through the analysis of the co-occurrence network, seven distinct thematic clusters emerge that reflect the most frequent research correlations. The terms “digital entrepreneurship,” “sustainable development goal,” “entrepreneurial ecosystem,” “economic growth,” and “digital technologies” occupy a central position in the network, confirming the close relationship between digital transformation, entrepreneurship, and sustainability. In addition, the interconnections between social inclusion and financial integration are also visible, as are theoretical references to concepts such as “social cognitive theory” and “academic research,” highlighting both the applied and theoretical dimensions of the field. The visual representation confirms the trend observed in this study that the concepts of digital entrepreneurship and technologies for SDGs form a dynamic and multifaceted ecosystem, which is structured around technological, social, and institutional components.

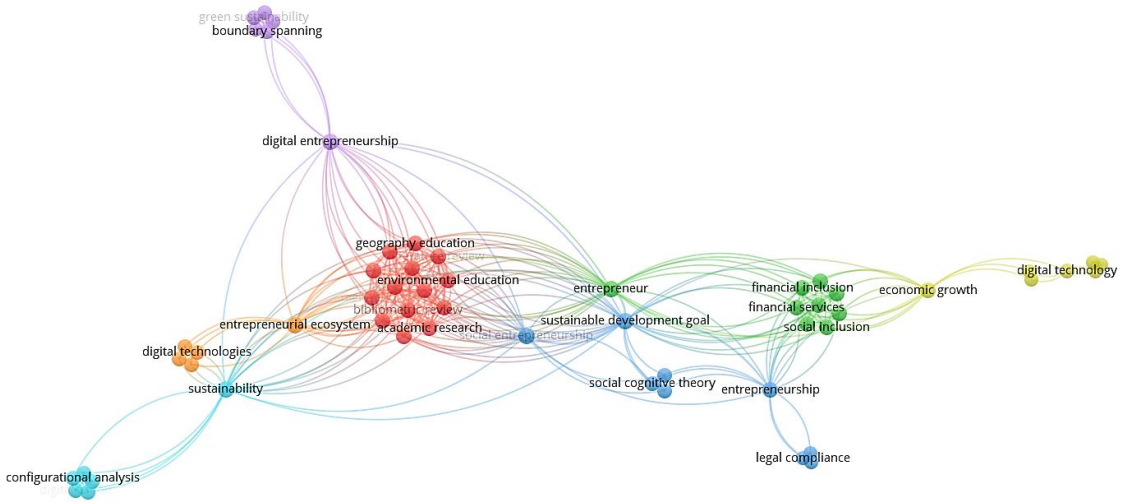

Figure 3. Network visualization of keyword co-occurrences from the reviewed literature using VOSviewer.

We therefore conclude that integrating the SDGs into digital entrepreneurship is not only a necessity to adapt to the new reality, but also an opportunity to redefine the role of business in

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addressing the major challenges of the 21st century. This overview provides a foundation for future research initiatives that will further explore this rapidly developing but still unexplored field.

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Abbreviations

The following abbreviations are used in this manuscript:

SDGs	Sustainable Development Goals
IoT	Internet of Things
ESG	Environmental, Social, and Governance
DEI	Diversity, Equity, and Inclusion
ERP	Enterprise Resource Planning
CSR	Corporate Social Responsibility
AI	Artificial Intelligence
ML	Machine Learning
EMS	Environmental Management Systems
ROI	Return on Investment
UN	United Nations
GEM	Global Entrepreneurship Monitor
TFP	Total Factor Productivity
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
LCA	Life Cycle Analysis
SMEs	Small and Medium-sized Enterprises
CRM	Customer Relationship Management
WoS	Web of Science
VOSviewer	Visualization of Similarities Viewer (bibliometric mapping software tool)

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