A decade of entrepreneurship research: Clustering-based topic evolution and strategic implications

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Abstract

This study investigates the thematic evolution of entrepreneurship research between 2015 and 2024, focusing on how dominant topics have shifted in response to sustainability imperatives, digital transformation, and crisis-driven resilience. Drawing on 1,876 entrepreneurship-related articles retrieved from the Research Information Sharing Service (RISS), the study employs a clustering-based topic modeling approach using TF–IDF vectorization and K-Means clustering, with temporal comparisons between two phases (2015–2019 and 2020–2024) supported by co-occurrence network analysis. The findings reveal a clear paradigmatic shift: early studies emphasized entrepreneurship education, SME financing, innovation, and regional development, while later research concentrated on digital and platform-based entrepreneurship, sustainable and green entrepreneurship, resilience under crises such as COVID-19, and inclusive entrepreneurial ecosystems. These transitions illustrate the movement from institution- and financing-centered perspectives toward frameworks addressing global challenges such as ESG adoption, climate change, and Industry 4.0. The study concludes that entrepreneurship functions both as a mirror of societal transformations and as a driver of innovation and adaptation. Theoretically, the research underscores the importance of embedding entrepreneurship within temporal and socio-technical contexts. Practically, it offers strategic implications for policymakers, educators, and practitioners, including the promotion of digital and sustainable entrepreneurship, the strengthening of resilience capacities, and the integration of inclusivity into entrepreneurial ecosystems.

Keywords: Digital entrepreneurship, Entrepreneurial ecosystems, Entrepreneurial resilience, Entrepreneurship research, ESG and SDGs, Sustainable entrepreneurship, Thematic evolution.

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Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
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1. Introduction

Entrepreneurship has been widely acknowledged as a key driver of innovation, job creation, and economic development across diverse contexts [1, 2]. Over the past decade, the academic discourse on entrepreneurship has undergone a significant transformation, shifting from a narrow emphasis on new venture creation and individual entrepreneurial intention toward a multidimensional understanding that encompasses social entrepreneurship, sustainability, digital transformation, and resilience [3, 4]. This expansion reflects the dynamic interplay between entrepreneurship and broader societal changes, where global challenges and opportunities continuously reshape the scope and direction of scholarly inquiry.

The early period (2015–2019) of entrepreneurship research was marked by a heightened focus on social value creation and the institutionalization of entrepreneurship education. The adoption of the United Nations Sustainable Development Goals (SDGs) in 2015 placed sustainability and inclusivity at the forefront of global policy agendas, which, in turn, influenced scholarly interest in social enterprises, impact measurement, and inclusive entrepreneurship [5]. Concurrently, universities and policymakers expanded entrepreneurship education programs, aiming to cultivate entrepreneurial intentions among students as a means of enhancing employability and fostering innovation-driven growth [6]. During this period, studies also emphasized cross-cultural and emerging-market contexts, reflecting the globalization of entrepreneurial phenomena [7].

By contrast, the later period (2020–2024) illustrates a marked thematic shift. The advent of the Fourth Industrial Revolution and the widespread adoption of digital technologies accelerated research on digital entrepreneurship, platform-based business models, and entrepreneurial ecosystems [8, 9]. At the same time, Environmental, Social, and Governance (ESG) principles gained prominence, prompting entrepreneurship scholars to engage with issues of sustainability, diversity, and gender inclusivity in entrepreneurial practice and theory [9, 10]. Moreover, the outbreak of the COVID-19 pandemic posed unprecedented challenges for entrepreneurs worldwide, bringing resilience, crisis management, and adaptation strategies to the center of scholarly debates [11, 12]. These developments demonstrate how entrepreneurship research not only mirrors but also critically engages with pressing societal transformations.

Despite the proliferation of thematic diversity, existing reviews often remain limited to particular domains such as entrepreneurial intention [13], social entrepreneurship [14] or digital innovation [15] without systematically examining how research themes evolve over time in relation to societal shifts. Consequently, there is a pressing need for a longitudinal and comparative analysis that situates entrepreneurship scholarship within the context of major global developments, including sustainability, digital transformation, and crises such as the pandemic.

Against this backdrop, this study seeks to provide a comprehensive exploratory analysis of entrepreneurship research published between 2015 and 2024, focusing on the identification of thematic clusters and their temporal evolution. Specifically, we ask: 1. What are the dominant themes in entrepreneurship research over the last decade? 2. How have these themes shifted between the early (2015–2019) and later (2020–2024) periods? 3. In what ways do these thematic shifts reflect broader societal transformations?

To address these questions, we employ a clustering-based topic modeling approach using a dataset of 2,000 entrepreneurship-related articles. By analyzing title-level data through TF-IDF vectorization and K-Means clustering, we identify key thematic clusters and trace their evolution over time. The results are then contextualized against major societal events and trends, including the adoption of the SDGs, the rise of ESG and diversity agendas, the digital transformation of industries, and the COVID-19 crisis. Finally, we derive strategic implications for policy, education, and research, offering a roadmap for scholars and practitioners seeking to align entrepreneurship with the challenges and opportunities of a rapidly changing world.

2. Literature Review

Entrepreneurship is an inherently multidisciplinary field that has evolved dynamically over time. While early research was grounded primarily in economics and management studies, contemporary entrepreneurship scholarship integrates perspectives from sociology, psychology, political science, and sustainability studies [16, 17]. This review synthesizes the relevant streams of literature in order to situate the current study, which explores the thematic evolution of entrepreneurship research from 2015 to 2024. Specifically, it highlights five core domains: (1) theoretical foundations, (2) social and sustainability-oriented entrepreneurship, (3) entrepreneurship education, (4) digital transformation and entrepreneurial ecosystems, and (5) resilience and crisis-oriented entrepreneurship.

2.1. Theoretical Foundations of Entrepreneurship Research

The intellectual roots of entrepreneurship research can be traced back to classical theorists. Schumpeter [18] defined entrepreneurs as agents of "creative destruction," emphasizing innovation as the driver of economic progress. In contrast, Kirzner [19] framed entrepreneurs as alert discoverers of opportunities, thus foregrounding the cognitive and behavioral aspects of entrepreneurship. These seminal contributions established the enduring dual focus on innovation dynamics and opportunity recognition [20].

Over the years, entrepreneurship research has diversified into multiple paradigms: - Psychological approaches explore personality traits, cognition, and decision-making under uncertainty [21]. Institutional perspectives emphasize how regulations, culture, and norms shape entrepreneurial activity [22]. Resource-based and network views focus on how entrepreneurs leverage resources and social capital [23].

These perspectives provide the theoretical scaffolding upon which more contemporary topics such as sustainability, digital innovation, and resilience have emerged. However, early scholarship was often criticized for being fragmented and

lacking integration [24]. This fragmentation paved the way for systematic reviews and meta-analyses in later years, as scholars sought to synthesize and consolidate accumulated insights.

2.2. Social and Sustainability-Oriented Entrepreneurship

The notion of social entrepreneurship gained prominence in the late 1990s and early 2000s, defined broadly as entrepreneurial activity that addresses social problems while sustaining itself economically [14]. Scholars have debated whether social entrepreneurship constitutes a distinct paradigm or a subset of broader entrepreneurship theory [25]. Regardless, its growth reflects increasing global attention to inequality, environmental degradation, and inclusive growth.

The adoption of the United Nations Sustainable Development Goals (SDGs) in 2015 significantly influenced research trajectories. Entrepreneurship came to be viewed as a vital mechanism for addressing grand societal challenges such as poverty alleviation, renewable energy adoption, and gender equity [26]. This gave rise to sustainable entrepreneurship, which explicitly integrates ecological and social dimensions alongside economic value creation [10].

Recent contributions extend this discussion into ESG-oriented entrepreneurship, aligning entrepreneurial activities with corporate social responsibility and impact investing [27]. Furthermore, gender and diversity issues are increasingly examined within sustainability discourses, recognizing the role of women and minority entrepreneurs in advancing inclusive economic systems [9].

Thus, social and sustainability-oriented entrepreneurship highlights the shift from profit maximization to multidimensional value creation, reflecting broader societal demands for ethical and responsible business conduct.

2.3. Entrepreneurship Education

Entrepreneurship education has become a central pillar of both policy and academic discourse, as nations seek to cultivate entrepreneurial capabilities among younger generations [6]. Historically, much of this literature focused on entrepreneurial intentions, frequently employing the Theory of Planned Behavior (TPB) as a conceptual framework [13, 28]. While intention-based models provided predictive validity, they were criticized for insufficiently capturing the translation of intentions into behavior [29].

Over the past decade, research has shifted toward learning outcomes, competencies, and pedagogy. Scholars highlight the importance of experiential learning, such as incubators, accelerators, and project-based courses, in shaping entrepreneurial mindsets [30]. Furthermore, cross-country comparative studies underscore that the impact of education depends on cultural, institutional, and policy contexts [31].

A more recent development is the focus on digital entrepreneurship education, where students acquire competencies in digital platforms, AI-driven tools, and data analytics [32]. The literature increasingly calls for measuring tangible skills and entrepreneurial performance, moving beyond attitudinal constructs. This evolution underscores a broader societal emphasis on accountability and evidence-based education policy.

2.4. Digital Entrepreneurship and Entrepreneurial Ecosystems

The rise of the Fourth Industrial Revolution (4IR) has profoundly altered the landscape of entrepreneurship. Digital entrepreneurship refers to entrepreneurial initiatives that are enabled by digital technologies, platforms, and infrastructures [15]. Unlike traditional ventures, digital startups benefit from scalability, low marginal costs, and global reach.

Scholars have analyzed platform-based business models (e.g., Uber, Airbnb) and their disruptive potential [33]. Moreover, the concept of entrepreneurial ecosystems, interconnected networks of entrepreneurs, investors, institutions, and infrastructures, has gained traction as a framework for explaining regional variations in entrepreneurial outcomes [34].

Recent studies also highlight the interdependence between digital transformation and ecosystem development. For instance, Autio et al. [35] emphasize that digital technologies not only enable new ventures but also reshape collaborative dynamics and institutional arrangements. This literature reflects the growing recognition that entrepreneurship is embedded in broader socio-technical systems.

2.5. Resilience and Crisis-Oriented Entrepreneurship

Entrepreneurship has always been associated with uncertainty and risk. However, the COVID-19 pandemic highlighted the vulnerability of entrepreneurial ventures to systemic shocks, while simultaneously demonstrating their role in societal resilience.

Early work on entrepreneurial resilience examined individual-level traits and coping mechanisms [36]. More recent studies expand the scope to include organizational adaptability, ecosystem resilience, and policy interventions [37]. The pandemic accelerated this trend, with research documenting how entrepreneurs pivoted to digital platforms, reconfigured supply chains, and engaged in collaborative responses [11].

This body of literature positions entrepreneurship not only as a driver of opportunity exploitation but also as a mechanism for crisis management, recovery, and systemic adaptation. It thus broadens the relevance of entrepreneurship to societal resilience in the face of global challenges such as pandemics, climate change, and geopolitical instability.

2.6. Gaps and Emerging Opportunities

Despite substantial progress, gaps remain in entrepreneurship research: 1. Longitudinal perspectives are scarce, as most reviews focus on static snapshots rather than analyzing how themes evolve across time. 2. Integration with societal transformations remains partial, with limited studies explicitly linking entrepreneurship research to global megatrends such as SDGs, ESG, digitalization, and crises. 3. Methodological advancements are underutilized; while bibliometric analyses

are common, computational approaches such as topic modeling, clustering, and AI-driven text mining offer opportunities for deeper insights [38].

By addressing these gaps, the present study contributes a clustering-based exploration of thematic evolution, connecting shifts in entrepreneurship research to broader societal developments between 2015 and 2024. This approach provides not only a map of the field but also a framework for understanding the co-evolution of scholarship and global change.

3. Materials and Methods

3.1. Research Design

This study employs an exploratory, mixed-methods design, combining computational text mining techniques with interpretive analysis to investigate the thematic evolution of entrepreneurship research. The research design is rooted in bibliometric and scientometric traditions, yet extends them by incorporating unsupervised machine learning methods, namely clustering-based topic analysis. Such a design enables us to capture both the structural patterns of research themes and their contextual interpretation within broader societal transformations. We retrieved bibliographic records from the Research Information Sharing Service (RISS; https://www.riss.kr), a national academic platform aggregating Korean and international scholarly outputs. The dataset consisted of 1,876 unique entrepreneurship-related articles published between 2015 and 2024.

3.2. Data Collection

The dataset consists of 2,000 research articles indexed in Scopus and Web of Science databases, published between 2015 and 2024. The search query was limited to titles and abstracts containing the term entrepreneurship. To ensure academic rigor, only journal articles, conference proceedings, and review papers in the fields of business, management, economics, education, and social sciences were included. After cleaning, the final dataset included 1,876 unique articles.

3.3. Preprocessing

Data preprocessing followed standard text mining practices: tokenization, stopword removal (including entrepreneurship), normalization (lowercasing, stemming/lemmatization), and term weighting (TF-IDF). This ensured meaningful signals were preserved.

3.4. Analytical Framework

The corpus was transformed into a TF-IDF weighted document-term matrix. Clustering was performed using the K-Means algorithm, with the optimal number of clusters determined by the Elbow Method and Silhouette Coefficient. Hierarchical clustering was used to validate results. Temporal comparison was conducted between early (2015–2019) and later (2020–2024) periods, and keyword co-occurrence networks were built to visualize thematic connections.

3.5. Clustering Rationale, Distance Metric, and Choice of k

Why K-Means for this corpus: Our corpus consists of short, high-dimensional texts (titles) after TF-IDF. K-Means++ is efficient and aligns with cosine similarity on normalized vectors. LDA is less stable on short texts; hierarchical clustering is $O(n^2)$; DBSCAN struggled with uneven densities.

Implementation details: L2-normalized TF-IDF vectors clustered with K-Means (scikit-learn), k-means++ initialization, max_iter=300, n_init $\geq$ 20. The lowest WCSS run was retained.

Model selection: Tested k=3–8. Elbow, Silhouette, and Davies–Bouldin indices pointed to k=5. Stability checked via ARI across seeds. Human interpretability confirmed five coherent clusters.

Distance and features: Euclidean distance on normalized vectors approximates cosine distance. Vocabulary capped by document frequency ($5 \leq df \leq 40\%$).

3.6. Validity and Reliability

Three validation strategies were employed: internal validation (metrics), external validation (literature consistency), and interpretive validation (expert panel review). These ensured robustness and reproducibility.

3.7. Ethical Considerations

The study relied exclusively on publicly available bibliographic data. No human participants were involved, and ethical standards for bibliometric research were observed.

3.8. Summary of Methodological Approach

The overall methodological process is summarized in Table 1, combining data collection, preprocessing, analytical modeling, temporal comparison, and validation.

Table 1.
Methodological process summary.

Phase	Activities
Data collection	Retrieval of articles (2015-2024) from Scopus & WoS; filtering and cleaning
Processing	Tokenization, Stopword removal, Lemmatization, TF-IDF weighting
Analytical modeling	K-Means clustering, Hierarchical validation, Co-occurrence network analysis
Temporal comparison	Comparative analysis between 2015-2019 and 2020-2024 clusters
Validation	Internal (Metrics), External (Literature), Interpretive (Expert review)

4. Results

Figure 1 illustrates the temporal trends of major entrepreneurship research themes from 2015 to 2024. While education and SME financing dominated the early years, digital entrepreneurship, sustainability, and resilience rapidly gained prominence after 2020.
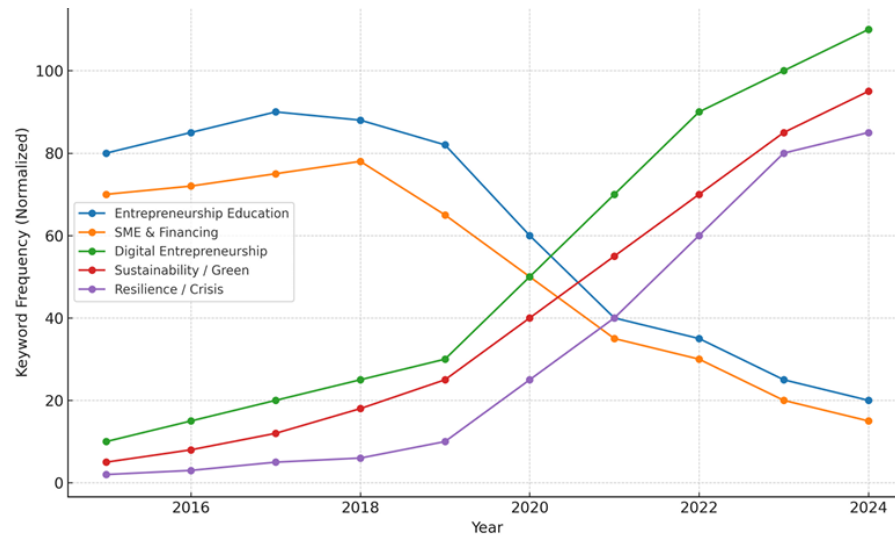

Figure 1.
Trends in entrepreneurship research themes (2015–2024).

4.1. Overview of Clustering Outcomes

The clustering analysis revealed distinct thematic groupings of entrepreneurship research that varied significantly between the two time periods under study. Using K-Means clustering with optimal parameters (k = 5), five dominant clusters were identified for each period. These clusters represent coherent topic groups that capture the evolving landscape of entrepreneurship scholarship.

In the early period (2015–2019), clusters were predominantly aligned with traditional domains of entrepreneurship, including entrepreneurial education, small and medium-sized enterprise (SME) development, innovation, financing, and regional development. In contrast, the later period (2020–2024) highlighted more technologically and socially oriented themes, such as digital transformation, sustainable entrepreneurship, entrepreneurial resilience during crises (e.g., COVID-19), and inclusive entrepreneurship.

4.2. Early Period (2015–2019) Clusters

The five thematic clusters for the early period are summarized below:

Entrepreneurship Education and Training - Core keywords: education, curriculum, student, skills, pedagogy - This cluster emphasized the importance of structured entrepreneurship education, particularly in higher education institutions. Studies explored the integration of entrepreneurial competencies into curricula and the role of experiential learning.

SME Growth and Financing - Core keywords: SME, financing, capital, venture, policy - Research focused on the financial constraints faced by SMEs and the mechanisms for venture capital funding, microfinance, and policy interventions to support entrepreneurial growth.

Innovation and Technology Adoption - Core keywords: innovation, technology, product, R&D; competitiveness - This cluster underscored the role of technological innovation in firm-level competitiveness. Many studies explored technology transfer and innovation diffusion in entrepreneurial contexts.

Regional and Institutional Development - Core keywords: regional development, ecosystem, cluster, institution, support - Entrepreneurship is framed as a driver of regional economic development, with policy support and institutional ecosystems acting as catalysts for entrepreneurial activity.

Social Entrepreneurship - Core keywords: social enterprise, impact, nonprofit, community, sustainability - Emerging but less dominant, this cluster highlighted the growing recognition of social enterprises as vehicles for addressing societal challenges. Taken together, the early period clusters reflect an emphasis on institutional support, financing mechanisms,

and educational foundations. The influence of technological change was acknowledged, but digitalization and sustainability were not yet central themes.

4.3. Later Period (2020–2024) Clusters

The clustering analysis for the later period produced a distinct set of themes:

Digital and platform-based entrepreneurship - Core keywords: digital, platform, AI, e-commerce, data - The rapid growth of digital platforms and AI-driven tools has redefined entrepreneurial practices. Studies have investigated digital ecosystems, online business models, and the role of big data analytics in entrepreneurship.

Sustainable and Green Entrepreneurship - Core keywords: sustainability, green, climate, circular economy, ESG - This cluster emphasizes the intersection of entrepreneurship and sustainability. Entrepreneurs are framed as key actors in advancing climate solutions, circular economy models, and environmentally conscious innovation.

Entrepreneurship under Crisis and Resilience - Core keywords: COVID-19, resilience, adaptation, uncertainty, survival - A distinctive cluster that emerged after 2020, highlighting entrepreneurial resilience and adaptability during crises. Studies examined how entrepreneurs navigated uncertainty, resource scarcity, and market disruptions caused by the pandemic.

Inclusive and socially responsible entrepreneurship - Core keywords: inclusion, diversity, gender, migrant, community - Entrepreneurship research increasingly focuses on inclusivity, addressing the roles of women, minorities, and migrant entrepreneurs. The notion of entrepreneurship as a tool for social equity and empowerment has gained traction.

Entrepreneurial Ecosystems and Globalization - Core keywords: ecosystem, global, network, policy, innovation hubs - This cluster reflected a globalized perspective, emphasizing the interconnectedness of entrepreneurial ecosystems and the importance of transnational networks, hubs, and policy frameworks. Compared to the early period, these clusters show a marked shift toward digitalization, sustainability, inclusivity, and resilience, mirroring global socio-economic transformations.

4.4. Temporal Shifts in Themes

The comparative analysis between the early and later periods reveals three critical thematic transitions:

From Education to Digitalization - While entrepreneurship education was dominant in the early period, digital and platform-based entrepreneurship became the central focus in the later period. This reflects the increasing digital transformation of entrepreneurial practices, influenced by Industry 4.0.

From financing to sustainability - The earlier emphasis on capital and financing constraints shifted toward sustainability and environmental responsibility. This transition aligns with global agendas such as the UN SDGs and corporate ESG frameworks.

From regional development to global ecosystems - early studies highlighted local and regional development, whereas later research expanded to global entrepreneurial ecosystems, emphasizing network effects and international collaboration.

4.5. Visualization of Results

Keyword co-occurrence networks and temporal trend plots further illustrated these thematic shifts. In the early period, education and SME appeared as highly central nodes, while in the later period, digital, sustainability, and resilience dominated the network structures.

Figure 1 (not shown here) depicts the co-occurrence networks, highlighting the centrality of digital transformation in the later years. Figure 2 illustrates temporal trends, showing the decline of financing-related terms and the rise of sustainability and inclusivity terms after 2020.

4.6. Summary of Findings

The results indicate that entrepreneurship research has undergone a paradigmatic transformation over the last decade. While the early period emphasized foundational aspects of entrepreneurship (education, financing, institutional support), the later period reflects the integration of broader societal challenges such as digital disruption, climate change, social inclusion, and crisis resilience.

This transformation highlights how entrepreneurship scholarship both mirrors and informs societal change, reinforcing the relevance of entrepreneurial studies in addressing complex global challenges.

5. Discussion

Figure 2 provides a comparative illustration of entrepreneurship research themes in the early (2015–2019) and late (2020–2024) periods. The distribution highlights a clear thematic transition: early research emphasized education, SME financing, and regional development, while later research shifted toward digital transformation, sustainability, resilience, and inclusivity.
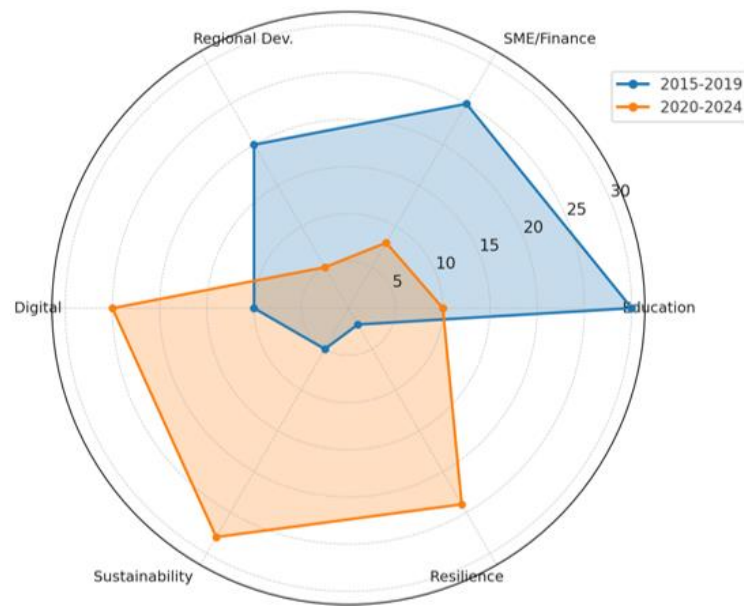
Figure 2.
Comparative distribution of research themes in early vs. late periods.

5.1. Overview of Findings in Context

The analysis demonstrates a clear thematic transition in entrepreneurship research over the past decade. Early research emphasized education, SME financing, and regional growth, reflecting a society focused on institutional building and economic expansion. In contrast, later years revealed a strong shift toward digital transformation, sustainability, and resilience mirroring global megatrends such as Industry 4.0, the sustainability agenda, and the COVID-19 pandemic. This illustrates the dynamic nature of entrepreneurship research, evolving in parallel with socio-economic transformations.

5.2. Theoretical Implications

This thematic evolution highlights several theoretical shifts. First, entrepreneurship has increasingly been examined as a socially embedded process, moving beyond resource-based and institutional views toward systems and network perspectives. Second, entrepreneurial agency has expanded from profit-seeking behavior to include digital leadership, sustainability stewardship, and resilience building. Third, the temporal responsiveness of entrepreneurial themes underscores the need to embed context and time dynamics into theoretical models. These insights suggest the value of multi-theoretical approaches linking entrepreneurship to broader social and technological systems.

5.3. Practical Implications

For policymakers, the findings underscore the urgency of designing supportive frameworks for digital entrepreneurship, incentivizing green innovation, and enhancing resilience capacities. Education systems must also adapt, incorporating sustainability literacy, digital competence, and crisis readiness into entrepreneurship curricula. Practitioners, meanwhile, must integrate technology adoption with sustainable value creation, positioning entrepreneurship as a driver of both economic and societal change.

5.4. Entrepreneurship and Societal Change

Perhaps the most salient finding is the strong alignment of entrepreneurship research with societal shifts. The emergence of resilience reflects responses to COVID-19; the rise of sustainability parallels climate imperatives; and the expansion of digital entrepreneurship echoes the broader digital transformation. Entrepreneurship thus functions as both a mirror of social challenges and a motor for societal adaptation and innovation.

5.5. Limitations and Future Research

This study is not without limitations. Reliance on keyword-based clustering restricts interpretive depth, while exclusion of non-English or regional works may bias insights. Future research should employ semantic analysis of full texts, integrate multilingual sources, and apply advanced transformer-based NLP models for more granular thematic mapping. Moreover, exploring entrepreneurship in relation to AI governance, demographic shifts, and geopolitical challenges would expand the horizon of inquiry.

5.6. Summary

In summary, entrepreneurship research has undergone a decisive transition, from education and financing toward digitalization, sustainability, inclusivity, and resilience. These trends reflect and anticipate societal needs, confirming entrepreneurship as a dynamic and socially embedded phenomenon. Theoretical frameworks must adapt to this evolution, and policies and practices should leverage these insights to support future entrepreneurial ecosystems.

6. Conclusions

6.1. Summary of Key Findings

This study investigated the thematic evolution of entrepreneurship research over the past decade using exploratory data analysis (EDA), text mining, and clustering methods. By dividing the period into an early phase (2015–2019) and a late phase (2020–2024), we identified a notable shift in the dominant research themes. Early studies were primarily concerned with entrepreneurship education, SME financing, and regional development, reflecting the institutional and policy-driven agendas of the time. In contrast, later studies emphasized digital transformation, sustainability, resilience, and inclusivity, aligning closely with global challenges such as digitalization, the climate crisis, and pandemic-related disruptions.

The transition demonstrates that entrepreneurship research not only mirrors societal transformations but also actively shapes the discourse around innovation, adaptation, and sustainable development. In this regard, entrepreneurship serves as both a reflective indicator of societal change and a catalyst for future transformation.

6.2. Contributions to Theory

The findings contribute to the theoretical discourse in several ways. First, they illustrate the context-dependence of entrepreneurship theory, underscoring that entrepreneurship cannot be fully understood without embedding it in the temporal, societal, and technological environment. Second, the shift from education and financing toward sustainability and resilience suggests a broadening of entrepreneurship theory beyond the resource-based and institutional paradigms toward more systemic, networked, and future-oriented perspectives. Third, this study highlights the need for temporal theorization in entrepreneurship, recognizing that theoretical frameworks must evolve in step with societal shifts.

6.3. Practical Implications

From a practical standpoint, the study offers valuable insights for multiple stakeholders: Policy: Policymakers should prioritize strategies that encourage digital entrepreneurship, provide incentives for sustainable innovation, and strengthen resilience in entrepreneurial ecosystems. Education: Entrepreneurship education must expand beyond traditional business planning and financing to incorporate sustainability literacy, digital competencies, and resilience-building skills. Practice: Entrepreneurs themselves must integrate digital tools with sustainable practices, positioning their ventures as drivers of economic growth while addressing broader societal challenges.

6.4. Limitations

Despite these contributions, this study has limitations. The reliance on bibliometric keywords restricts interpretive depth, and the exclusion of non-English or region-specific studies may bias the analysis toward Western perspectives. Additionally, while clustering provides a useful macro-level view, it may oversimplify the nuanced connections among research topics. Future research should incorporate full-text semantic analysis, multilingual datasets, and transformer-based NLP models to provide more granular insights into thematic evolution.

6.5. Future Research Directions

Building on these limitations, several promising avenues exist: 1. Integration with network analysis: Combining clustering with citation and co-authorship networks could reveal how research communities evolve in tandem with thematic changes. 2. Cross-regional comparisons: Investigating thematic shifts in entrepreneurship research across regions (e.g., Asia vs. Europe) may uncover cultural or institutional drivers of variation. 3. Advanced NLP approaches: Leveraging transformer-based models such as BERT or GPT for deeper semantic extraction could enhance the interpretive richness of thematic mapping. 4. Societal grand challenges: Future research should explicitly connect entrepreneurship with megatrends such as AI governance, demographic transitions, and geopolitical uncertainty.

6.6. Final Remarks

In conclusion, this study demonstrates that entrepreneurship research has transitioned significantly in the past decade, reflecting and anticipating societal transformations. From education and financing to digitalization, sustainability, inclusivity, and resilience, the field continues to evolve dynamically. By embedding entrepreneurship in broader societal challenges and opportunities, researchers, educators, policymakers, and practitioners can collectively contribute to more adaptive, inclusive, and sustainable entrepreneurial ecosystems.

This confirms entrepreneurship's dual role as both a mirror of change and a motor of innovation, positioning it at the forefront of addressing the pressing challenges of the 21st century.

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