UNVEILING THE IMPACT : A BIBLIOMETRIC ANALYSIS OF VIRTUAL BUSINESS INCUBATORS IN FOSTERING SCIENTIFIC RESEARCH VALORIZATION AND STARTUP PROMOTION

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Abstract

In the dynamic landscape of business and innovation, incubators play a pivotal role in fostering economic growth and creativity. This study conducts a concise bibliometric analysis to examine the evolution of research on virtual incubators and their business models. The objective is to outline the field's development, analyze current trends, highlight models supporting digital entrepreneurship, and identify areas for further investigation. Findings offer essential insights into virtual incubators, serving as a foundational resource for enhancing their efficacy in the Algerian entrepreneurial ecosystem and fostering economic growth and innovation.

***Keywords**: Virtual incubators, Digital entrepreneurship, Bibliometric analysis, Business models, Economic growth.*
***JEL Codes :** L26, M13, 031.*

Résumé

Dans le domaine dynamique des affaires et de l'innovation, les incubateurs jouent un rôle central dans la croissance économique et la créativité. Cette étude réalise une analyse bibliométrique concise pour examiner l'évolution de la recherche sur les incubateurs virtuels et leurs modèles d'affaires. L'objectif est de détailler le développement du domaine, analyser les tendances actuelles, mettre en lumière des modèles soutenant l'entrepreneuriat numérique et identifier des axes de recherche. Les résultats offrent des perspectives essentielles sur les incubateurs virtuels, constituant une ressource fondamentale pour renforcer leur efficacité dans l'écosystème entrepreneurial algérien, favorisant la croissance économique et l'innovation.

***Mots-clés** : Incubateurs virtuels, Entrepreneuriat numérique, Analyse bibliométrique, Modèles d'affaires, Croissance économique.*
***Classification JEL:** L26, M13, 031.*

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Introduction

Incubators have a vital role in fostering economic growth and sustainable social development, serving as catalysts for entrepreneurship, innovation, and technology across various sectors. (Ririh, Laili, Wicaksono, & Tsurayya, 2020). They contribute significantly to the generation of employment opportunities and wealth, offering diverse support services to bolster the survival and growth of startups, existing businesses, or entrepreneurial teams, especially during vulnerable phases (Ratinho & Henriques, 2010). This support encompasses access to consultancy services, training sessions, networking, venture capital (Mian, Lamine, & Fayolle, 2016), assistance in developing new products and services (Oliveira & Terence, 2018), and facilitating market entry and commercialization of products and services (Kennett, Hu, Maritz, & Sun, 2020; Wadid et al., 2018).

Business incubators are known as key promoters of sustainability, autonomy, profitability, and success for enterprises, often extending their impact beyond the initial incubation period. According to Kiran & Bose (2020), "incubated companies are more likely to survive than those that have not undergone incubation." This recognition has led to a notable increase in the business incubators number, largely supported by government policies and practices over the last decade (Abarca, Palos-Sánchez, & Rus-Arias, 2020; Kennett, Hu, Maritz, & Sun, 2020; Sunny & Shu, 2019).

In the Algerian context, the national incubation ecosystem is quite recent compared to more established ones in other countries such as the United States, Europe, or Asia. Sunny & Shu (2019) categorize six types of incubators, including business incubators, virtual incubators, networked incubators, university-based incubators, student-managed incubators, and social incubators. Additional classifications proposed by Bakkali, Messeghem, & Sammut (2013) encompass university incubators, independent commercial incubators, regional incubators, corporate internal incubators, technology business incubators, and virtual incubators.

While business incubator concepts and typologies have significantly evolved over time (Vaz, de Carvalho, & Teixeira, 2022), research on their diverse business models has only recently started to progress (Sansone, Andreotti, Colombelli, & Landoni, 2020). However, the importance of these economic models for incubators is well acknowledged, as they aid in pursuing incubator missions, supporting expected tenant growth, and enabling value creation and capture.

With a specific focus on virtual business incubator models, this paper aims to perform a bibliometric analysis and systematic literature review, Providing a thorough insight into the evolution and progress within this domain. It seeks to expand previous research by: (a) contributing new information and an extensive overview of developments in this area of academic research.; (b) Structuring established virtual incubator business models and offering additional insights into their operational execution to more effectively support occupants; (c) Formulating conclusions concerning a more appropriate model for virtual business incubators to improve the processes of creating digital businesses and developing startups. Three research questions lead this study.

1. How has research papers on the virtual business incubators' evolution progressed over time?
2. What are the existing models of virtual business incubators, and how are they structured to provide support for project initiators and startup projects development?
3. In examining virtual business incubator models, which emerges as the most fitting approach to enable digital business and startup development processes?

The methods and materials used in this research paper are then delineated in depth. Afterward, the presentation of results obtained from the systematic literature review and bibliometric analysis ensues. The article then advances to discuss the primary discoveries and their implications, ultimately concluding with an exploration of the study's limitations and suggestions for future research directions.

1.-Materials and Methods

To achieve the objectives of this study and address the research questions impartially, a hybrid methodology was employed, mixing bibliometric analysis and systematic literature review as proposed by Zupic and Čater (2015). The bibliometric analysis involved the use of the R Bibliometrix software (Aerts, Matthyssens, & Vandenbempt, 2007) to consider bibliographic data associated with digital business incubator models. VOSviewer was as well employed during the research report selection stage to create and visualize bibliometric networks (Radu, Radu, Tabirca, Saplacan, & Lile, 2021) of the filtered records.

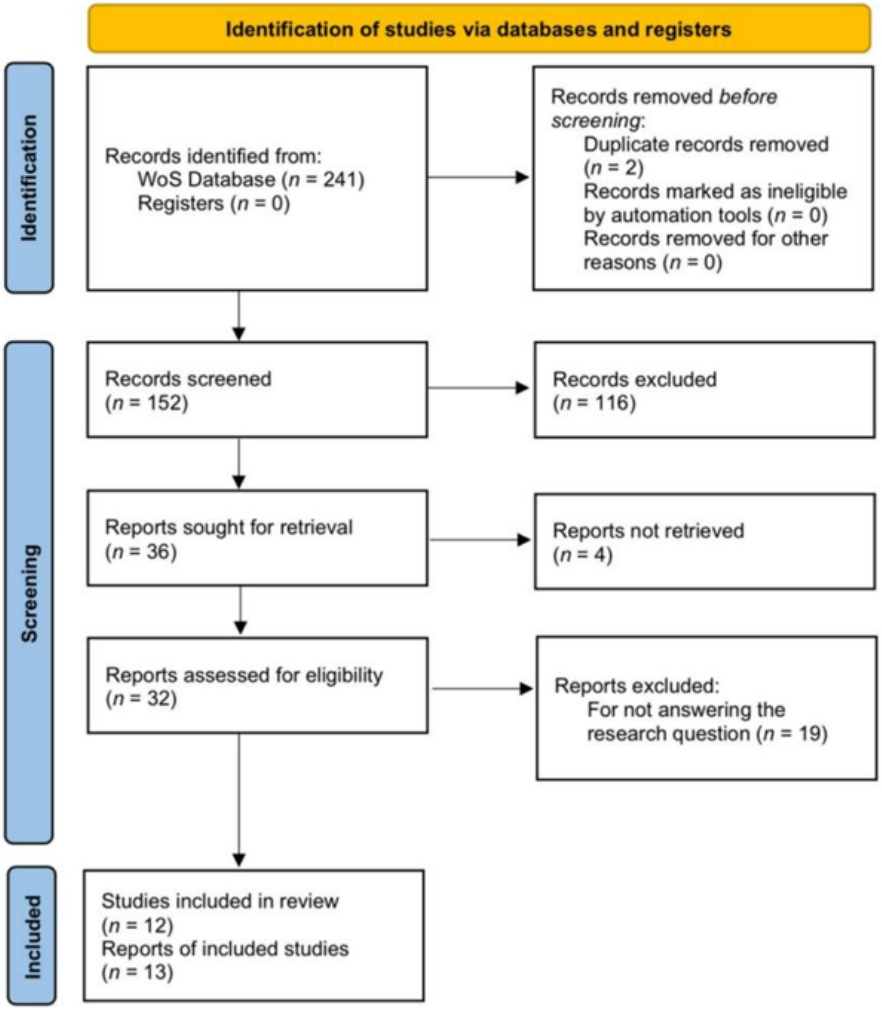
The systematic literature review comprised four main steps: planning, conducting, analyzing, and synthesizing retrieved data, following recommendations by Impellizzeri and M. (2012) and adhering to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). A comprehensive literature search was conducted on February 8, 2023, using the Web of Science database. The search string employed was "business AND incubat* AND (framework* OR model* OR design* OR development*) AND (virtual* OR digital* OR online)." A total of two hundred forty-one (241) records were initially retrieved, with tow (2) duplicates removed. No records were excluded at this stage.

Inclusion criteria for document selection included: (a) peer-reviewed articles and conference proceedings; (b) within specified categories related to management sciences and computer science; (c) published in English. No time limit was applied for record selection. The resulting sample consisted of one hundred fifty-two (152) records, which underwent VOSviewer analysis resulting in 63 records clustered into twenty-seven (27) groups through bibliographic coupling and twenty-two (22) records categorized into four (4) groups using the co-citation technique.

Due to limited network results and complementary bibliometric analysis revealing similar conclusions, and considering the novelty and limited research in the field, manual selection based on titles and abstracts was conducted. During this process, one hundred sixteen 116 records were excluded, resulting in thirty-six (36) sought-after reports. Unable to retrieve four (4) reports, only thirty-two (32) reports were evaluated for eligibility after full reading. During evaluation, 19 reports were excluded, and the final sample for qualitative in-depth analysis included thirteen (13) reports (involving twelve (12) studies).

Figure 1 illustrates the PRISMA flowchart, outlining the entire process undertaken for identification, selection, and exclusion phases to minimize bias in the analysis.

Figure 1. Research Flowchart



Source : Performed by authors

2.Results

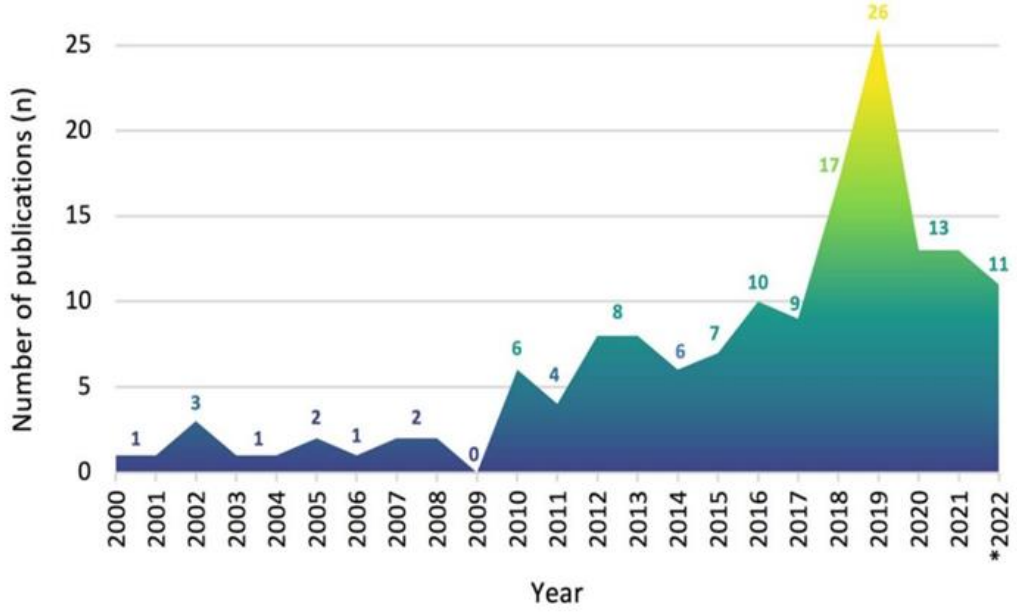
This section is partitioned into two primary subsections to offer a systematically organized presentation of results pertaining to: (a) the bibliometric analysis conducted on the examined records, and (b) the systematic literature review based on content analysis of reports derived from the included studies.

s illustrated in Figure 2, no time constraints were applied during the screening phase, revealing the emergence of the first article on virtual business incubation models in 2000. However, scientific output remained relatively limited until the end of 2009, comprising 9.3% of contributions in the field. Subsequently, there was an improvement in publication performance between 2010 and 2017, constituting 38.3% of the total. Notably, the most substantial volume of scientific publications on the Web of Science was recorded from 2018 onwards, amounting to 52.7%. This trend signifies a growing interest in the analyzed subject over the past five (5) years, despite a decrease in the number of records noted since 2020.

It is vital to highlight that the publications number presented for 2022 (11) is assessed up to the first of August, 2022, implying that this value is expected to increase in the next six

months by the beginning of 2023. This potential increase may surpass the publications number (13) from the preceding two years. Regarding the annual publications growth rate, the existing data lets us to conclude a rate of 11.50%, With an average of 11 citations per record.

Figure 2. Annual Evolution of published paper on Digital Business Incubation Models



Note: The count of publications for the year 2022 is determined using records published up to December 31, 2022.

Source: Authors' compilation from the SCOPUS and Web of Science databases

The refined scientific output originated from authors affiliated with institutions in 62 different countries. It can be deduced that the United States sixty-four (64), the United Kingdom thirty-nine (39), India thirty-seven (37), Germany thirty-four (34), and China thirty-three (33) comprised the top five (5) countries with the highest scientific production concerning digital business incubator models, collectively representing 29.2% of global performance. Algeria, the present research location, is ranked 13th, contributing 11 records over the past 22 years, constituting 1.7% of this scientific theme contribution in the Web of Science.

2.1.-Thematic Evolution and The Influence of Covid-19

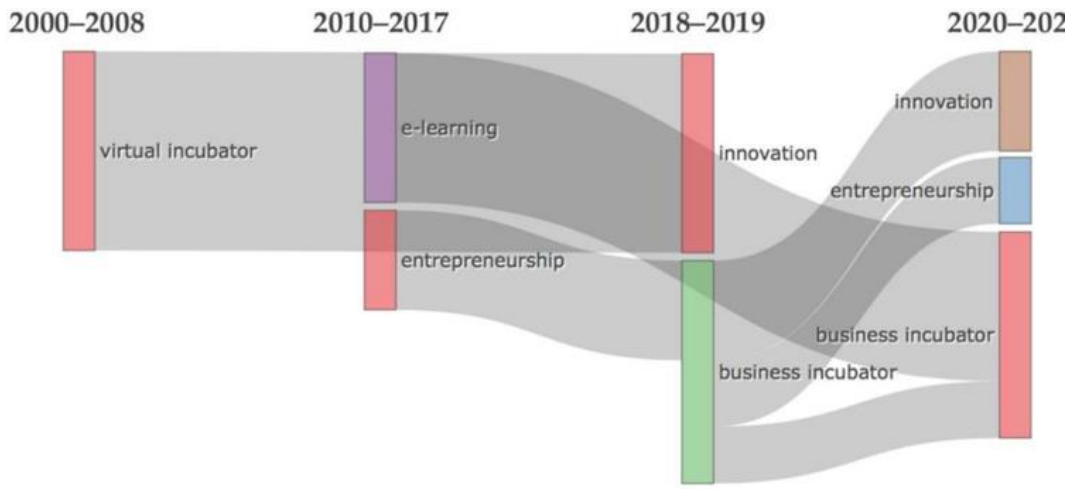
To obtain a comprehensive understanding of the thematic progression of research in the field throughout its evolution, four temporal horizons were considered in the analysis: 2000-2008, 2010-2017, 2018-2019, and 2020-2022. This approach was chosen based on the previously observed differences in published paper over time, rather than dividing sub-periods into equal periods.

Figure 3 illustrates the ultimate outcome, revealing 1, 2, or 3 thematic groups for each segmented time period. Additionally, it portrays the equivalent thematic evolution path, which emerges from the co-occurrence of keywords derived from filtered records in each scenario.

The analysis leads to the conclusion that the primary research emphasis from 2000 to 2008 revolved around the "virtual incubator" theme. This theme intersected with the themes of "e-learning" and "entrepreneurship" during the period from 2010 to 2017. The "virtual incubator" cluster completely dissipated in 2018-2019, indicating that researchers ceased to develop studies on this theme and instead focused on "innovation," along with the theme of "business incubator."

The thematic evolution diagram reveals that the last period (2020-2022) is a significant milestone in this research field, evolving for the first time into three thematic clusters: "innovation," "entrepreneurship," and "business incubator." In this case, both the "innovation" and "entrepreneurship" clusters stem from previous research (between 2018 and 2019) related to the theme of "business incubator," along with the new "business incubator" cluster, which started to incorporate the "e-learning" theme at its core.

Figure 3. The Thematic Evolution Diagram of Filtered Records between 2000 and 2022



Source: Performed by authors

Although these three clusters align closely with the expectations of a digital business incubator, the thematic evolution diagram analysis clearly reveals a research gap. Specifically, there is a deficiency in studies addressing the formulation of models or conceptual and empirical frameworks to underpin the presence of business incubators in the digital era. Once again, this factor underscores the imperative for research in this field. This is not only to advance academic discourse on supporting global entrepreneurship initiatives through digital platforms but also to contribute to enhancing digital practices and strategies. These advancements can foster innovation and the emergence of new business opportunities globally. Moreover, the identification of new themes post-2019 highlights specific areas of research related to the impact of COVID-19 on business incubation. Notably, themes such as "Digital Transformation in Response to the Pandemic" and "Innovative Solutions Amidst Crisis" have become prominent. This observation is particularly noteworthy as both the "innovation" and "entrepreneurship" clusters have evolved from previous research conducted between 2018 and 2019, primarily focused on the "business incubator" theme. Additionally, a new "business incubator" cluster has emerged, featuring the integration of the "e-learning" theme at its core during this period.

2.2.-Thematic Map

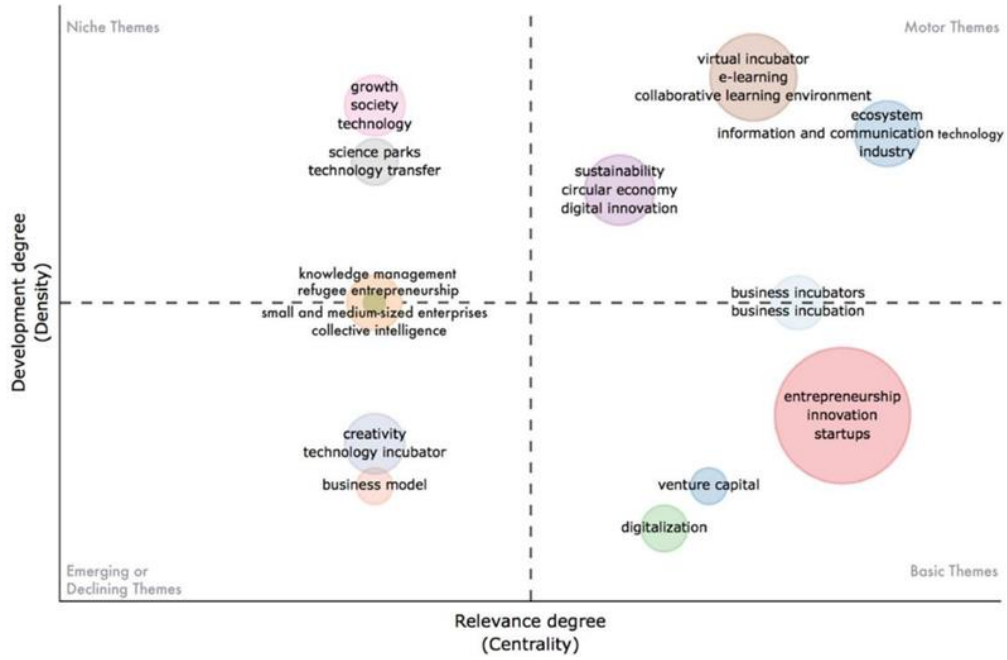
The final step of the conducted bibliometric analysis involved studying the thematic map presented in Figure 4, constructed from the keywords of the 152 filtered records. This strategic diagram outlines the network morphology with a set of clusters (13 in this specific case) systematized into four quadrants based on their centrality rank values (x-axis) and density (y-axis) in the study domain. The distinct cluster sizes help capture differences in the number of records associated with them. As the purpose of this stage was to acquire a comprehensive understanding of the key themes contributing to the development of the research field (rather than the methods followed by the authors during research), certain terms, such as "systematic review" and "case study," were removed to generate the final result, and it was defined that each group be labeled based on its three most recurrent main subjects.
The analysis of the thematic map allows for the following conclusions:
- The thematic map reveals several clusters representing distinct themes within the domain of virtual business incubator models. These clusters, positioned in different quadrants, provide insights into their significance and development within the research field:

- Upper-right quadrant (High Centrality, High Density):
  - "Virtual incubator," "e-learning," and "collaborative learning environment."
  - "Ecosystem," "information and communication technologies," and "industry."
  - "Sustainability," "circular economy," and "digital innovation."
- Lower-right quadrant (High Centrality, Low Development):
  - "Entrepreneurship," "innovation," and "startups."
  - "Venture capital" and "digitization."
- Upper-left quadrant (Low Centrality, High Development):
  - "Growth," "society," and "technology."
  - "Science parks" and "technology transfer."
- Lower-left quadrant (Low Centrality, Low Density):
  - Themes related to "creativity," "technological incubator," and "business model" have the potential to evolve into crucial emerging themes for the future development of this research field.

Other clusters can be mentioned:

- Clusters with the same density but opposite centrality, such as "business incubators" and "business incubation," indicate their importance to the research field, despite being less developed and warranting more attention in the future.
- The clusters on the left side containing themes like "knowledge management" and "collective intelligence," as well as "entrepreneurship of refugee students" and "small and medium enterprises," suggest niche themes that could be explored further to advance research on digital incubator models.

Figure 4. Thematic Map with Characterization of the 13 Clusters from Sorted Records



Source : Performed by authors

3.-Discussion

The discussion on the main results and implications of the research is organized into subsections based on the three research questions that guided this study.

3.1.-Evolution of Academic Research on Virtual Business Incubator Development

The bibliometric analysis of the initially selected 152 records from the Web of Science database indicates that academic production in the studied domain is emerging and remains underdeveloped. Although the first article on virtual business incubator models was published in 2000, it wasn't until 2018 that more than half of the scientific publications were recorded (52.7%). This observation aligns with the views of several authors (Bøllingtoft, 2012), who highlight that "studies on business models of incubators remain in their infancy" (Bøllingtoft, 2012, p. 92), with a focus on either physical or virtual modalities. The literature appears fragmented, and incubators have long been studied as a distinct phenomenon (Sansone, Andreotti, Colombelli, & Landoni, 2020, p. 152).

The analysis of thematic evolution indicates a shift in research focus over time. Until 2017, studies primarily concentrated on virtual incubators, online learning, and entrepreneurship. More recent studies establish connections between virtual business incubator models and themes of innovation, entrepreneurship, and business incubation.

The thematic map, illustrating the morphology of the network into 13 clusters, highlights three clusters with central importance in the field's development. These encompass themes such as virtual incubator, e-learning, collaborative learning environment; ecosystem, information and communication technologies, industry; and sustainability, circular economy, digital innovation. Future studies could delve into exploring the impact of different policies on these clusters.

3.2.-Existing Models of Virtual Business Incubators and Their Organizational Structures

The systematic literature review on virtual business incubator models underscores two primary facets. Firstly, the constrained number of incorporated studies (12) accentuates the scarcity of research dedicated to this specific topic. The scrutinized literature reveals that the majority of reports evaluated for eligibility concentrated on diverse and unrelated subjects (Zahra & Wright, 2016). Secondly, none of the investigated studies adhered to a systematic literature review approach in formulating virtual incubation models, thereby underscoring the significance of the present research.

3.3.-Suitability of Virtual Business Incubator Models for Supporting Digital Entrepreneurship or Startups Creation Process

Concerning the third research question, the outcomes of the systematic literature review do not provide conclusive evidence regarding the most suitable model for facilitating the incubation process and assisting tenants in the establishment of a digital enterprise or startup. The underdeveloped state of research and the fragmented existing knowledge pose challenges in identifying a unified model that could serve as a guiding framework for managers, academics, organizations, and other professionals interested in embarking on a successful journey in creating and managing a virtual business incubator.

In light of these circumstances and with the aim of contributing to the advancement of research in this field, the subsequent phases of this research project will concentrate on formulating a unified model for virtual business incubators. The essential insights gleaned from the systematic literature review will be taken into account to integrate identified perspectives, encompassing organizational and business management, information and communication systems, as well as user experience and engagement. Furthermore, a participatory design approach will be adopted to iteratively develop and enhance the unified model. This approach involves actively seeking input from incubator tenants to comprehend their needs and expectations throughout the incubation process, and organizing discussion groups with diverse incubator experts to continuously validate or redesign the virtual business incubator model (Yin & Luo, 2018).

Conclusion

In conclusion, this research embarked on a comprehensive exploration of virtual business incubators, employing a hybrid methodology of systematic literature review and bibliometric analysis. The study aimed to unravel the global and Algerian landscape, understand thematic evolution, and provide insights into the existing models and their suitability for supporting the creation and development of digital enterprises.

The bibliometric analysis illuminated the dynamic trends in scientific production, revealing a significant surge in interest since 2018. While the global landscape showcased thematic clusters such as virtual incubator, e-learning, and innovation, Algeria's contribution, though modest, indicated a growing presence and influence in this domain. The annual growth rate and citation metrics underscored the increasing scholarly impact of Algerian research.

The thematic evolution analysis identified key clusters like innovation, entrepreneurship, and business incubation, highlighting the transformative journey of virtual business incubators over the years. The impact of COVID-19, reflected in emergent themes post-2019, emphasized the adaptability and resilience required in virtual incubation strategies.

Concerning the existing models of virtual business incubators, the systematic literature review indicated a scarcity of studies, emphasizing the necessity for dedicated research in this

domain. The absence of a unified model tailored for digital enterprises further emphasized the need for future research endeavors.

The study's focus on Algeria revealed the country's position in the global discourse on virtual business incubators. While the research output has been commendable, there's ample room for localized studies aligning with national priorities. The conclusion draws attention to the potential synergies between the identified thematic clusters and Algerian policies, advocating for a strategic alignment to enhance the impact of virtual business incubators on scientific research valorization and startup promotion in Algeria.

Looking ahead, the research proposes a proactive approach in the creation of a unified model for virtual business incubators. This model, developed iteratively through a participative design approach involving stakeholders and entrepreneurs, can serve as a guide for practitioners, policymakers, and researchers in Algeria and beyond.

In essence, this research contributes to the ongoing discourse on virtual business incubators, providing a nuanced understanding of their global and Algerian contexts. The findings serve as a foundation for future research, policy formulation, and practical initiatives aimed at fostering innovation, scientific research valorization, and the growth of startups in the digital landscape.

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