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Woman STEMpreneurs vs women BioEmpreneurs

Mujeres STEMpreneurs vs Mujeres BioEmpreneurs

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Palabras Clave: Mujeres STEMpreneurs, Mujeres emprendedoras en Biotech, Entrepreneurship

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ABSTRACT

Context: This study explores women's entrepreneurship in **STEM** (Science, Technology, Engineering, and Mathematics) and biotech, addressing the underrepresentation and unique challenges they face. Despite increased attention, a research gap exists in comparing the entrepreneurial experiences of women in these fields.

Purpose: Aligned with the transdisciplinary emphasis, the research integrates knowledge across disciplines to deepen the understanding of women's entrepreneurship in **STEM** and biotech, fostering sustainable practices.

Problem: The identified underrepresentation of women in **STEM** and biotech entrepreneurship and the need for more specific comparative studies form the basis of the research problem. The overarching question centers on unraveling the distinct challenges faced by women in these two fields to provide insights that can inform supportive measures and policies.

Methodology: Through a bibliometric analysis, this article identifies key differences. The **VOSviewer** platform is used to analyze the relationships among the nodes in the word clusters.

Theoretical and Practical Findings: Theoretical contributions arise from synthesizing insights, adding to the body of knowledge in entrepreneurship, particularly for women in **STEM** and biotech. Practical contributions are evident in the recommendations from the study, aimed at fostering sustainable practices and transdisciplinary collaboration in these sectors.

Transdisciplinary and Sustainable Innovation Originality: Lies in its focus on the intersection of transdisciplinarity and sustainable innovation within the context of women entrepreneurship in **STEM** and biotech. By addressing this unique intersection, the study adds value to the existing literature and offers novel perspectives on supporting women in these fields.

Conclusions and Limitations: The study underscores the need for targeted support mechanisms, emphasizing transdisciplinary collaboration and sustainable practices for gender equity. Acknowledging limitations opens opportunities for future research into gender disparities in entrepreneurship in scientific and biotechnological domains.

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RESUMEN

Contexto: Este estudio explora el emprendimiento de mujeres en **STEM** (Ciencia, Tecnología, Ingeniería y Matemáticas) y biotecnología, abordando la subrepresentación y desafíos únicos que enfrentan. A pesar de la creciente atención, existe una brecha de investigación en la comparación de las experiencias empresariales de mujeres en estos campos.

Propósito: En sintonía con el énfasis transdisciplinario, la investigación integra conocimientos entre disciplinas para profundizar la comprensión del emprendimiento de mujeres en **STEM** y biotecnología, fomentando prácticas sostenibles.

Problema: La identificada subrepresentación de mujeres en el emprendimiento de **STEM** y biotecnología, junto con la falta de estudios comparativos específicos, constituye la base del problema de investigación. La pregunta principal se centra en desentrañar los desafíos distintivos que enfrentan las mujeres en estos dos campos, con el objetivo de proporcionar ideas que puedan informar medidas y políticas de apoyo.

Metodología: A través de un análisis bibliométrico, este artículo identifica diferencias clave, utilizando la plataforma **VOSviewer** para analizar la relación de los nodos en los conglomerados de palabras.

Hallazgos Teóricos y Prácticos: Las contribuciones teóricas surgen de la síntesis de ideas, agregando al cuerpo de conocimiento en emprendimiento, especialmente para mujeres en **STEM** y biotecnología. Las contribuciones prácticas se evidencian en las recomendaciones que surgen del estudio, dirigidas a fomentar prácticas sostenibles y colaboración transdisciplinaria en estos sectores.

Originalidad en Transdisciplinariedad e Innovación Sostenible: Radica en su enfoque en la intersección de la transdisciplinariedad y la innovación sostenible en el contexto del emprendimiento de mujeres en **STEM** y biotecnología. Al abordar esta intersección única, el estudio agrega valor a la literatura existente y ofrece perspectivas novedosas sobre el apoyo a las mujeres en estos campos.

Conclusiones y Limitaciones: El estudio subraya la necesidad de mecanismos de apoyo específicos, haciendo hincapié en la colaboración transdisciplinaria y prácticas sostenibles para la equidad de género. Reconocer las limitaciones abre oportunidades para futuras investigaciones sobre disparidades de género en el emprendimiento en ámbitos científicos y biotecnológicos.

1. INTRODUCCIÓN

This study delves into the vital importance of science, technology, engineering, and mathematics (**STEM**) for technological development and innovation, driving economic and social growth (Waad et al., 2021). Despite increasing attention, there needs to be more research gap in comparing women's entrepreneurial experiences in these fields. In Australia, the percentage of women enrolled in university-level **STEM** education increased by only 2% in four years, from 24% in 2015 to 26% in 2019, despite comprising a quarter of students. While the percentage of women working in skilled **STEM** industries increased by 4% from 24% in 2016 to 28% in 2020, men remain 1.8 times more likely to work in a **STEM** occupation. The proportion of women in management increased by 5% from 18% in 2016 to 23% in 2020 (**STEM** Equity Monitor, 2021). In universities, women are considered underrepresented among graduate entrepreneurs in **STEM** fields, despite being crucial drivers of technological innovation that contributes to national wealth (Piva & Rovelli, 2021).

Although entrepreneurship is a top priority in the current economic context for promoting social and economic progress, especially in **STEM** due to its impact on the competitiveness and innovation of countries, women face significant challenges in starting a business, making them less likely to succeed as entrepreneurs (Guzman & Kacperczyk, 2019). The gender gap in **STEM** entrepreneurship originates from a complex set of problems rooted in a gender-socialized belief system. This gap widens as women progress through different career levels. Barriers faced by women **STEMpreneurs** (women entrepreneurs in **STEM**) include internal factors such as a lack of hard and soft skills to start a business and external factors like work-life balance, societal roles, limited access to finance, and a lack of multidisciplinary collaboration (IDB, 2020). While increasing female enrollment in **STEM** is a common approach (currently at only 36%, **STEM** Equity Monitor, 2021), it should not be the sole measure for encouraging female entrepreneurship, as small actions can drive change to achieve gender diversity, inclusivity, and equity, critical commercial priorities (Burks, 2021).

Barriers for women entrepreneurs in biotech and biomedical industries mirror those in **STEM**, including challenges in business management, administrative aspects, family responsibilities, and breaking traditional gender and science models. Women entrepreneurs in both sectors face unique obstacles; biotech entrepreneurs, in particular, grapple with challenges related to product

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commercialization and talent acquisition. In contrast, women entrepreneurs in **STEM** primarily contend with underrepresentation (Hafsi & Hu, 2021). Addressing these barriers is crucial for promoting gender equality in entrepreneurship and advancing innovation in these fields, given the difficulty women face in establishing scientific businesses (Hill et al., 2017).

Despite the significant attention the biotechnology industry receives for its potential to drive innovation and economic growth, women still encounter challenges in accessing funding and leadership opportunities. Unfortunately, the representation of women entrepreneurs in biotechnology remains lower than desired. However, women entrepreneurs in biotechnology are more likely to hold higher education degrees and patents and receive external funding for their ventures compared to women entrepreneurs in other **STEM** fields (NWBC, 2021).

Various integrative approaches are needed to change the current perception of female entrepreneurship (King, 2000), such as developing gender-sensitive business education programs, interdisciplinary connections, and specialized mentorships (Sirt, 2019). Integrating training, education, and soft skills to arm them with the tools needed to develop entrepreneurial intention (Guzmán, 2021). Taking into consideration the behavior of the individual that affects the motivation in the decision-making process of creating a business (Cervantes-Guzmán, 2019)

While the subject has gained greater notoriety in recent years, with bibliometric analysis providing insights into research trends and knowledge dissemination, studies on women's entrepreneurship in Biotech are still scarce (Sharma, 2022), and there is a lack of research on business ecosystems addressing this issue (Neumeyer, 2022). This article aims to fill this literature gap through a bibliometric analysis, evaluating the interrelation and diagnosing the theme to increase the number of women entrepreneurs in Biotechnology.

The primary research question in this article is: What insights can be gained from the literature review of women entrepreneurs in **STEM** that can contribute to increasing the number of women entrepreneurs in **Bio-MedTech**?

The hypothesis posits that increasing the number of female students in the field of study does not necessarily lead to a more significant number of women entrepreneurs in **Bio-MedTech**.

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2. CONTEXT DESCRIPTION

At the global level, the prevailing notion suggests that increasing the number of women pursuing university careers in **STEM** can potentially lead to more women entrepreneurs. However, a significant contrast emerges in biotechnology, where 40% of women choose to study, yet only 28% venture into entrepreneurship (Surdez, 2020). This discrepancy challenges the simplistic assumption that merely boosting female enrollment in **STEM** fields will naturally translate into increased entrepreneurial activity. Therefore, a more nuanced approach is required, focusing on developing specific programs to nurture the entrepreneurial intentions of women within academic settings.

It is crucial to recognize that female entrepreneurship should extend beyond the development of hard skills, as defined by DeLong & Elbeck (2018) as *"the administrative or technical procedures that can be measured or quantified"* (p. 160). Unlike male entrepreneurship, female entrepreneurship should place greater emphasis on internal aspects, including the cultivation of soft skills, as defined by DeLong & Elbeck (2018) as *"the interpersonal, human, people, or behavioral skills needed to apply technical skills and knowledge in the workplace"* (p. 160). Additionally, attention must be directed toward external aspects, addressing the societal roles of women and strategies for overcoming associated barriers. The development of these multifaceted skills is deemed necessary for both industries, as women in **STEM** and biotechnology share similarities leading to a low percentage of entrepreneurs (Surdez, 2020).

At the national and international levels, despite a growing number of researchers and academics delving into the subject over the past two decades, the volume of articles specifically focusing on the study of women entrepreneurs in **STEM** still needs to be increased. This disparity is notable, particularly in comparison to the increasing number of articles published in 2021. Conversely, there is a relative scarcity of articles scrutinizing women entrepreneurs in biotechnology. This observed difference in research focus suggests a potential gap in understanding and addressing the challenges faced by women entrepreneurs in these fields.

In the global landscape, the intricate dynamics surrounding women's entrepreneurship in **STEM** and biotechnology warrant comprehensive exploration. The multifaceted factors influencing women's entrepreneurial endeavors, including societal perceptions, educational systems, and

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industry-specific challenges, require thorough investigation. The evolving state of the art and the ongoing efforts to bridge gender disparities necessitate a nuanced understanding of the context at various levels to inform effective policies and interventions that promote inclusivity and equitable opportunities for women in entrepreneurship.

3. LITERATURE REVIEW

The last five to ten years have witnessed an extensive body of research that brings into focus the persistent gender gap in biotech and biomedical entrepreneurship. This literature review endeavors to provide an in-depth exploration of the challenges faced by women in these fields, considering factors at the intersection of education, experience, societal norms, and cultural expectations.

3.1. The gender gap in biotech & biomedical entrepreneurship.

Recent studies have cast a spotlight on the enduring gender gap within **STEMpreneurship,** particularly in biotech and biomedical sectors. This phenomenon, once attributed to biological factors, is now recognized as a complex interplay of social and cultural influences. Despite a commendable increase in the percentage of women entrepreneurs, a substantial gender gap in **STEMpreneurship** persists. Notable contributors to this gap include the underrepresentation of women in **STEM** recruitment and an asymmetry between businesses founded by women and men. These factors collectively hinder the growth of female entrepreneurs in industries with substantial potential for expansion, income generation, public support, and venture capital investment (Kuschel et al., 2020).

3.2. Barriers in biotech entrepreneurship.

The biotech sector presents unique challenges for women entrepreneurs, encompassing professional, social, and personal obstacles that impede success in science and technology-related careers (Merrit, 2015). While there has been significant progress in reducing the gender gap in academic science, disparities persist in patenting, funding acquisition, and participation in scientific advisory boards. These challenges are multifaceted, emanating from the demands of family life, exclusion from certain professional circles, and the limited representation of women in specialized fields (McCook, 2013).

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3.3. Difference between women entrepreneurs in STEM and biotechnology.

In **STEM** companies, there has been a noticeable surge in women-led entrepreneurship in recent years. However, these endeavors exhibit the lowest growth rates compared to other professional areas. Internal factors, such as a lack of confidence among women entrepreneurs, often lead them to request less funding than required and present less robust business proposals. External factors, including biased questioning from venture capitalists, impact funding outcomes, with women receiving only 2% of total company financing (Demiralp et al., 2018).

In the biotech sector, women constitute a majority in human resources for commercial management and sales but are significantly underrepresented in scientific roles. Leadership positions for women have remained stagnant, revealing biases in invitations to boards and scientific advisory roles. Cultural attitudes, biases, and antagonism against women in science contribute to the lack of diversity in leadership, negatively affecting financial success and creating a talent underutilization problem in the biotech industry (Radcliffe Institute, 2015).

3.4. Challenges in both Sciences

Despite changes in the scientific landscape emphasizing commercialization, gender equity challenges persist. Demand-side factors contribute to gender discrimination in entrepreneurial endeavors, leading to reduced investment. Supply-side factors, including gender-specific preferences and time constraints, continue to shape women's career trajectories in **STEM** and biotechnology. Male-oriented identity perceptions, the valuation of stereotypical male traits, and biases against female ideas contribute to these persistent challenges (Greene & Brush, 2018).

3.5.Overcoming gender-specific challenges.

Successful women in male-dominated fields often face gender, cultural, social, and structural obstacles. These individuals must implement unique knowledge, perseverance, and passion to bring innovative ideas to fruition. Initiatives to encourage female entrepreneurship should extend beyond increasing enrollment. Special programs focused on entrepreneurial education, multidisciplinary team linkage, and mentorship support are crucial in fostering the entrepreneurial intentions of women in these industries (Furstenthal et al., 2022; Hopkins & Lodish, 2018).

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In summary, this comprehensive literature review underscores the intricate challenges faced by women in biotech and biomedical entrepreneurship. The persistent gender gap is a multifaceted issue rooted in social, cultural, and structural factors. Addressing these challenges demands a holistic approach involving academia, industry, and policymakers.

The identified hypotheses regarding internal and external challenges provide a solid foundation for further empirical investigation and model testing. The persistent disparities in funding, leadership positions, and venture capital highlight the need for targeted interventions at both organizational and societal levels. Promoting a gender-inclusive environment in **STEM** and biotechnology necessitates concerted efforts and a paradigm shift toward equality, diversity, and inclusivity.

As we navigate these challenges, an emphasis on equality, diversity, and inclusivity will be pivotal for shaping a more equitable landscape for women entrepreneurs in these critical sectors. Fostering mentorship programs, creating supportive ecosystems, and challenging unconscious biases are crucial steps towards dismantling barriers and fostering an environment where women can thrive as entrepreneurs in biotech and biomedical fields. The comprehensive understanding gained through this literature review lays the groundwork for informed and targeted interventions to address the gender gap in biotech and biomedical entrepreneurship.

3.6.The design of the final instrument

The objective of this publication is a bibliometric analysis and a field visualization based on the collection's publications on the **SCOPUS** platform, where the evolution of research on the subject of women entrepreneurs in **STEM** and the difference on women entrepreneurs in biotechnology from 2012 to 2022 is analyzed, the keywords, and the countries that published. Subsequently, the **VOSviewer** platform will be used to analyses the relationship of the nodes in the word clusters.

This article presents the path of development of research in the industry based on the articles of **SCOPUS**, after recovering, reviewing, and cleaning them following the methodology of Virgin, Cobo, & Betancourt (2014).

4. METHODOLOGY

Bibliometrics is defined, according to Bouyssou & Marchant (2011), as the analysis of the publications of scientific articles where the trend of the development of knowledge and the

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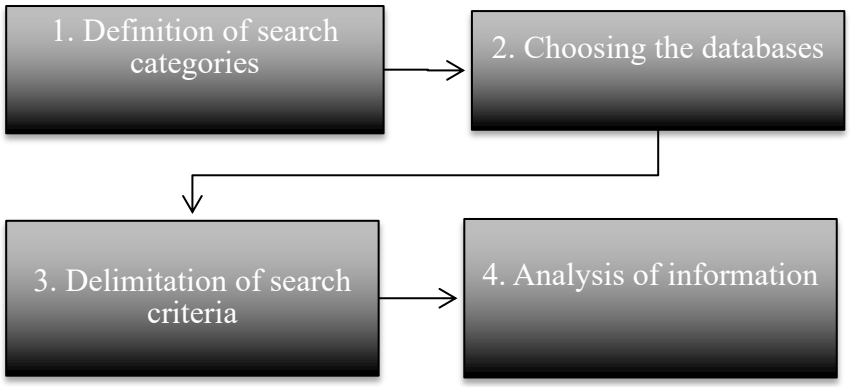
transformation of a discipline is identified. This allows us to identify the main characteristics of a topic, analyze the historical data, and find the patterns that complement the opinions of experts in each area, which will help in the evolution of scientific research.

In order to identify the amount of information analyzed from women entrepreneurs in **STEM** and biotech, the method for bibliometric analysis was proposed below, using the methodology used by Virgin, et al. (2014). See **Figure 1**.

Figure 1: Methodology for bibliometric analysis



Source: adapted from Virgin et al. (2014).

4.1. Defining search categories

According to the objective of systematizing the information available from women entrepreneurs in **STEM** and women entrepreneurs in biotech from recognized sources, the search criteria were determined using the search strategy using an indexed article related to the topic investigated by Virgin et al. (2014). The search categories in both databases were as follows (see **Tables 1, 2, and 3**).

Table 1. Searching terms SCOPUS

Row	Search string
1	"gender" or "women" or "female"
2	"Entrepreneurship" or "Entrepreneurs" or "Venture" or "Start-ups"
3	"**STEM**" or "Science, technology, engineering, and mathematics"

Source: Own

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Table 2. Search terms SCOPUS

Row	Search string
1	"gender" or "women" or "female"
2	"Entrepreneurship" or "Entrepreneurs" or "Venture", or "Start-ups"
3	"Biotechnology" or "Biotech" or "**Bio-MedTech**"

Source: Own

Table 3. Search criteria and results in SCOPUS

Database: SCOPUS	Criteria	Results
STEM	Search in: Topic	73
	Document type: Article	
	Subject area: Business, management, and accounting	
	Language: English	
	Peer review: yes	
	Publication data: 2012 to 2022	
Biotechnology	Search in: Topic	19
	Document type: Article	
	Subject area: Business, management, and accounting	
	Language: English	
	Peer review: yes	
	Publication data: 2012 to 2022	

Source: Adapted from Treanor & Marlow (2021), and Poggesi et al. (2020)

The searches were carried out with the different categories focused on the topic of the article, as there was little or no information about the topic, it was proceeded to select a broader search criterion to be able to analyse the general information of the topic, and then select the relevant information focused on the research topic.

4.2. Choosing the databases

To focus on the terms of reference, the search was carried out in ScOPUSs, a multi-disciplinary platform combining databases, abstracts, and complete citations containing the rigorously selected information from relevant scientific publications identified by experts (Elsevier, 2022). The platform was used in the research evaluation to compare from the perspective of its coverage. Web

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of Science was used for analysis, but the limited number of articles on the subject caused this platform to be discarded.

For the analysis of the database, the **VosViewer** software was used, which facilitates the visualization of data through two-dimensional maps so that the user has an easy understanding through a graphic representation (Van Eck & Waltman, 2019)

4.3. Delimitation of search criteria

The delimitation of the search criteria for women entrepreneurs in **STEM**, considering the publication period and the type of document, the articles published in the last 10 years from 2012 to 2022 were selected through a chronological filter, and the research was carried out in November 2022, to obtain the most recent publications on the subject. In addition, a relevance analysis was carried out according to the method of Virgin et al. (2014), taking into consideration that the articles that do not have some relevant information on the research topic, lack methodology, a research problem, a measurable methodology, and conclusive conclusions were discarded; for this, the information was collected and analyzed according to the criteria of year, source, summary, research problem, methodology, results, and conclusions.

4.4. Analysis of information

Next, they are presented in an analysis of the bibliometric indicators analyzed according to the indicators presented. To publicize the evolution of scientific production in the field of research of women entrepreneurs in **STEM** and biotech, the information was exposed in graphs to facilitate its visualization.

5. RESULTS

In this section, the results of the analysis of its evolution by year will be exposed, the keywords, the number of publications in per journal magazines, and the countries that published, in addition, to be presented the analyses of the relationship of the nodes in the word clusters.

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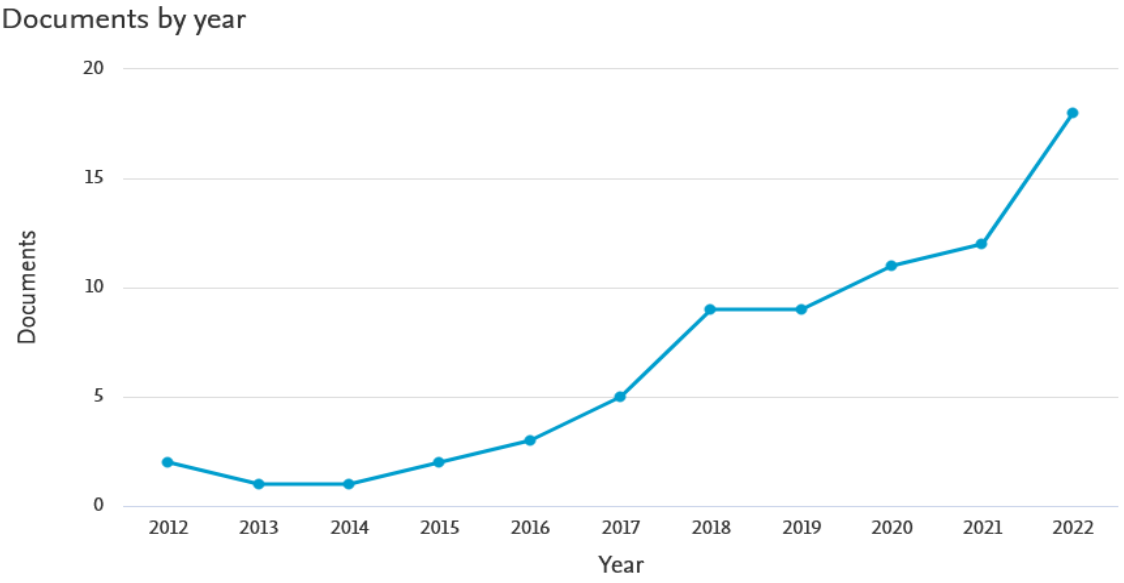
5.1. Analysis of the evolution of scientific production per year

In the **SCOPUS** database, the indicators of exponential growth of articles related to women entrepreneurs in **STEM** in 2022 were produced by 24%. The indicators have had a considerable increase in articles related to women entrepreneurs in biotech in 2022 produced by 21%. (See **Graphs 1 and 2**)

This exponential increase is because, although the pandemic can have a negative effect on women entrepreneurs, they learned to be resilient and evolve in a new business context. Despite this, it continues to be a sector with little participation of women despite being one of the fastest-growing sectors (GEM, 2021). The growing need for researchers to address more complex issues has led to increased research efforts, which provides a greater amount of knowledge and information (Russell, 2001).

Graph 1. Evolution of the scientific production per year of women entrepreneurs in STEM



Source: **SCOPUS** analysis based on keywords

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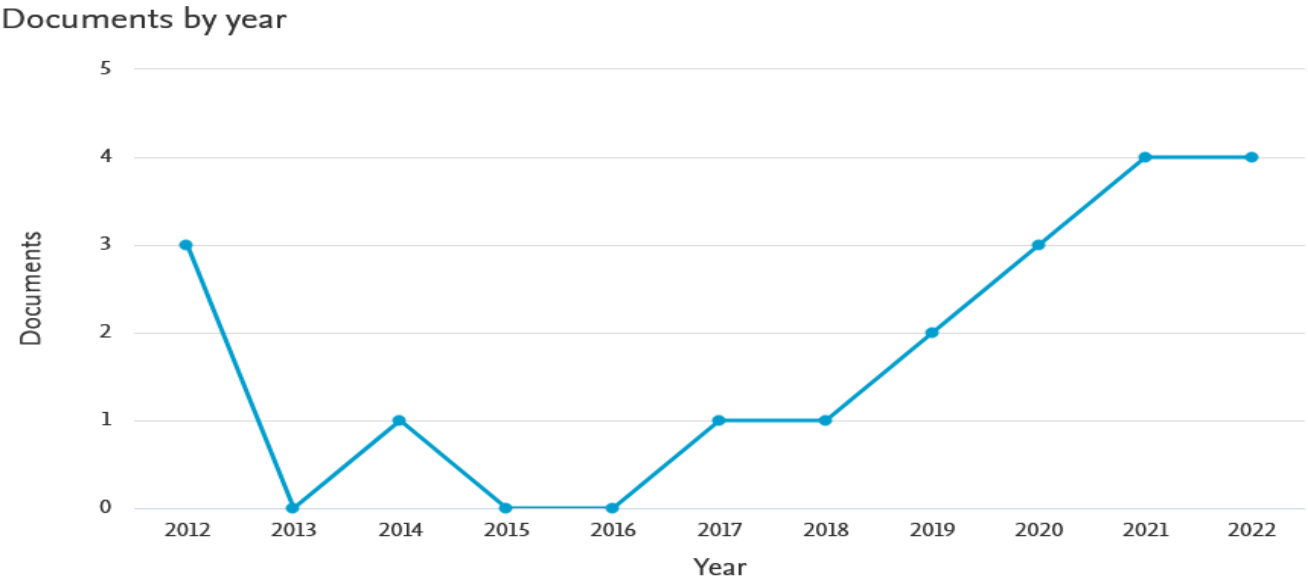
Graph 2. Evolution of the scientific production per year of women entrepreneurs in biotech



Source: **SCOPUS** analysis based on keywords

5.2. Analysis of the country that published

In the base of **SCOPUS**, the 10 countries with the most publications of studies on women entrepreneurs in **STEM** are presented. It is highlighted that the United States of America generates 21% of the scientific production in the field. And for the issue of women entrepreneurs in biotech, also the United States of America generates 31%. Possibly this is due to the economic resources allocated to research and development, the ranking of its universities, the scientific production of its research professors, etc., being the parameters considered for its position (QS, 2018). (See **Graphs 3 and 4**)

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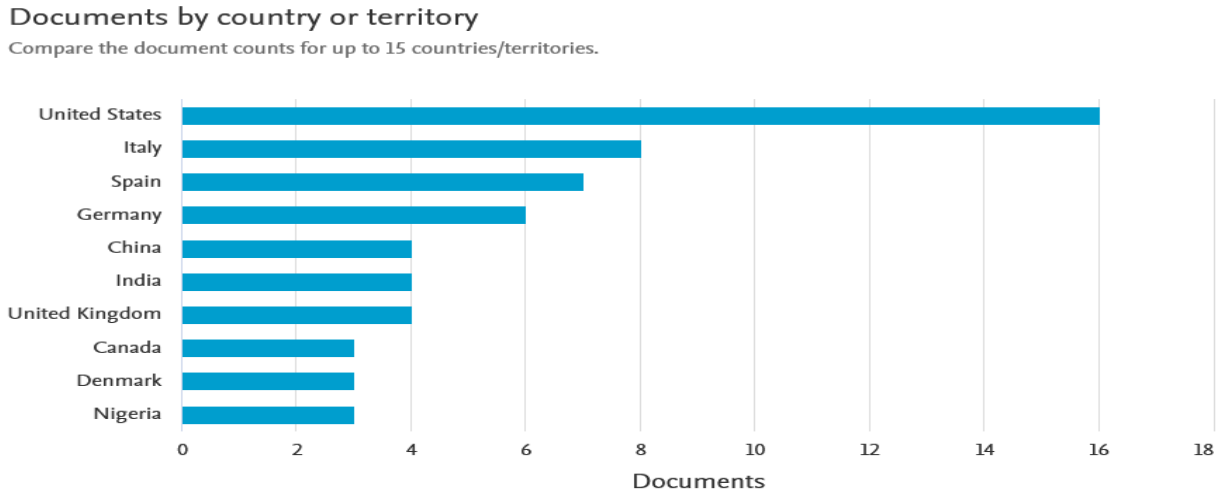
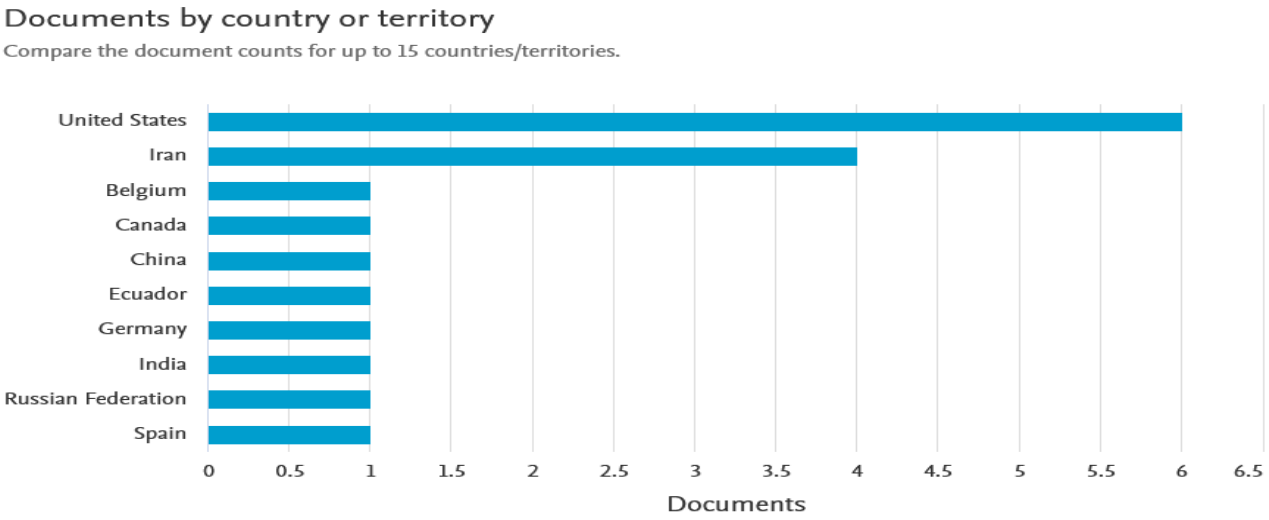
Graph 3. Number of publications per country on the topic of women entrepreneurs in STEM



Source: **SCOPUS** analysis based on keywords

Graph 4. Number of publications per country on the topic of women entrepreneurs in biotech



Source: **SCOPUS** analysis based on keywords

5.3. VosViewer analysis

Next, the nodes of the clusters of the evolution of the words by year and their bibliometric density map will be analyzed. **VosViewer** implements the normalization technique of the association force, then the technique of mapping the visualization of similarities, and later the grouping technique. A cluster is a set of nodes related according to the type of link that is analyzed by a specific color; the

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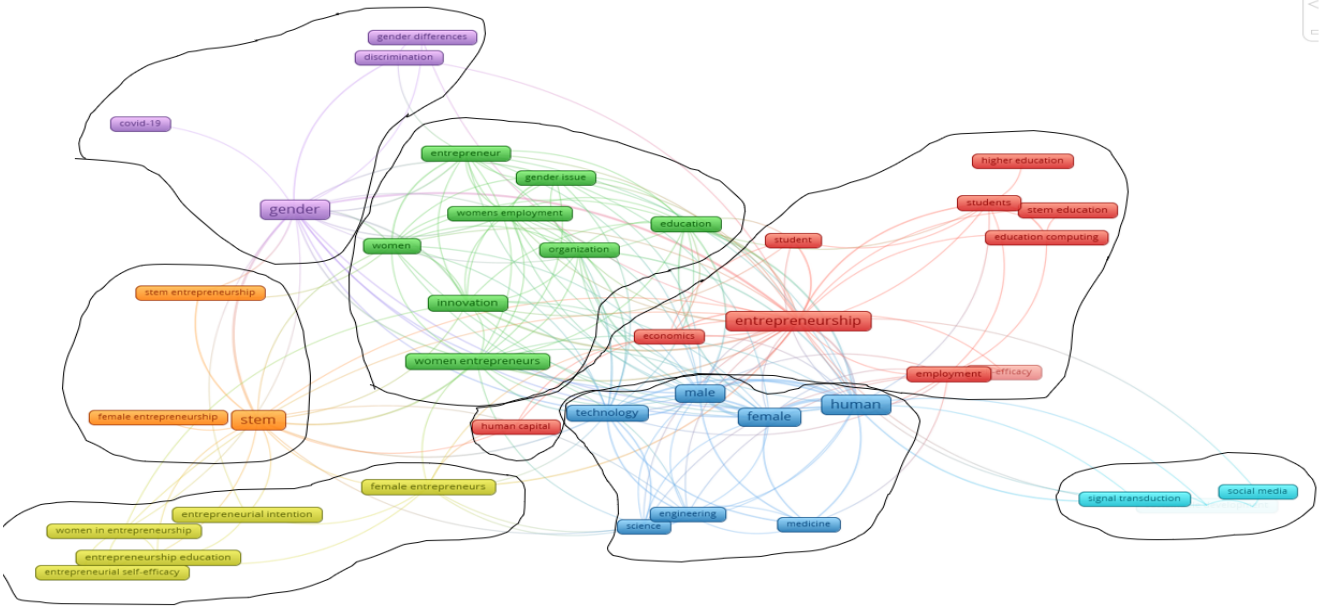
node is assigned exactly to a cluster, and the dimension of the circles means the level of importance and repetition in the different articles (Van Eck & Waltman, 2014).

5.3.1. Co-Words

In the **SCOPUS** base for the theme of women entrepreneurs in **STEM**, it can see the existence of five clusters differentiated by the colors green, yellow, blue, red, and purple. In the red cluster entrepreneurship predominates, in the green cluster it is women's entrepreneurship and innovation, in the yellow it is entrepreneurship education, in the blue it is female, and in the purple is gender. In the theme of women entrepreneurs in biotech, we can see the existence of three clusters differentiated by the colors green, blue, and red, in the blue cluster the word biotechnology and entrepreneurship predominate, in the red cluster is female, and in the green cluster are women, science, and mentor. It can be observed that in the first topic there is a greater predisposition in topics focused on gender and entrepreneurship, and in the second the predisposition is lower. (See **Graphs 5 and 6**).

Graph 5. Co-Words of the topic women entrepreneurs in STEM



Source: **VOSViewer** from **SCOPUS** keywords

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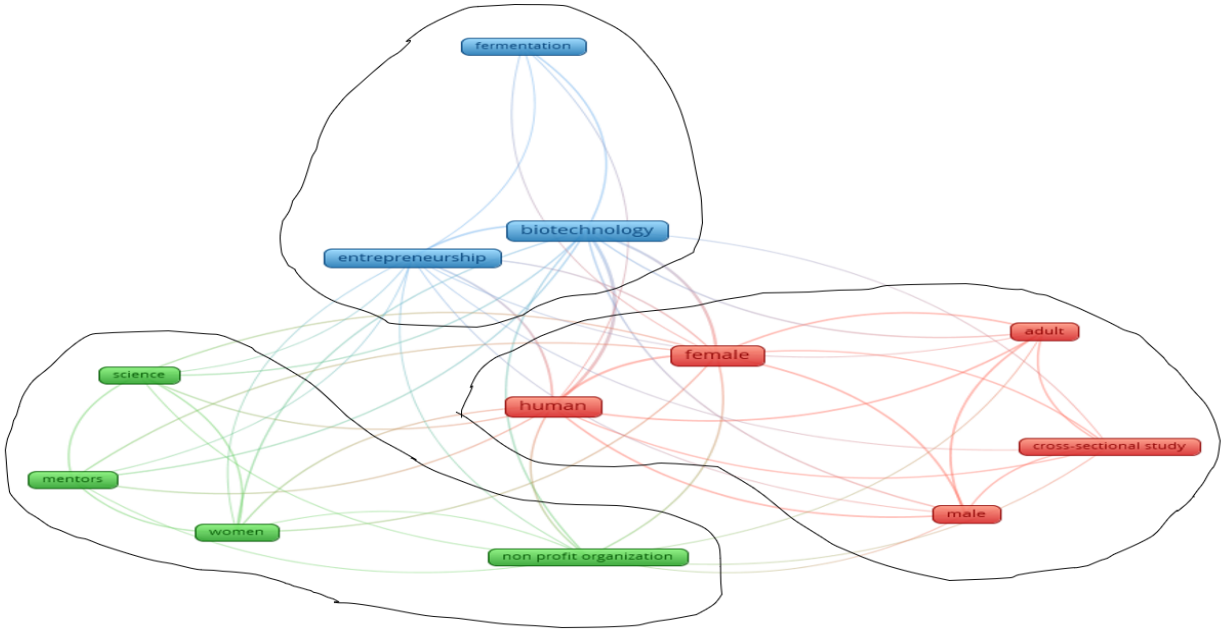
Graph 6. Co-Words of the topic women entrepreneurs in biotech



Source: **VOSViewer** from **SCOPUS** keywords

5.3.2. Evolution of co-words

As can be analysed in the graph of the evolution of words in the **SCOPUS** database of research on women entrepreneurs in **STEM**, they went from: technology and entrepreneurship, evolving to an approach oriented to: female entrepreneurship, stem entrepreneurship, and covid 19. For the topic of women entrepreneurs in biotech, they went from science and mentors to transcend toward a cross-sectional study. Exposing that in the first topic, there was progress toward a gender equity approach; on the contrary, in the second, there has been no transformation of research toward female entrepreneurship. The first investigations analyze women as a homogenous group, then analyze gender inequalities, to later analyze the influence of gender on women's entrepreneurial behavior, which caused gender to be recognized as a social construction instead of biological behavior (Lorna, 2022). (See **Graphs 7 and 8**).

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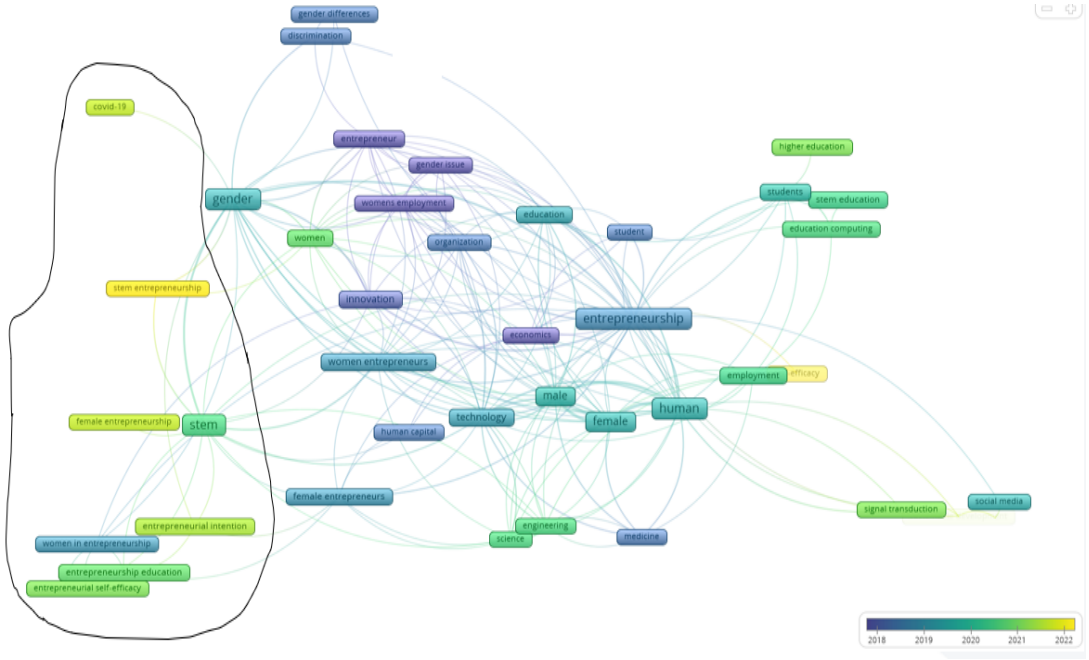
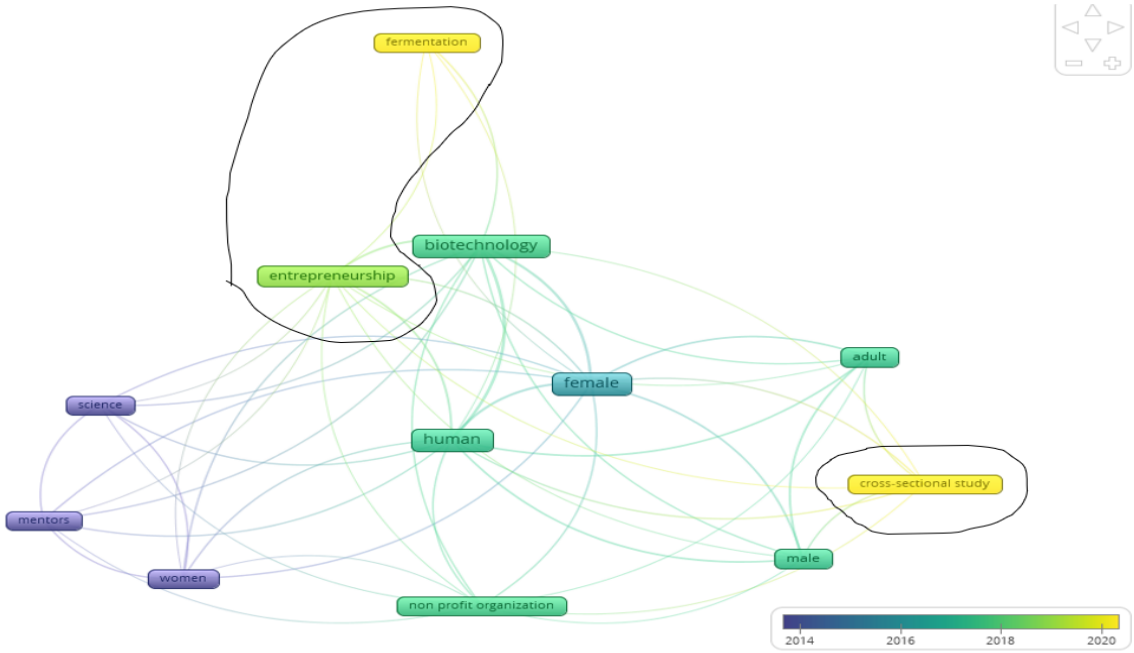
Graph 7. Evolution of co-words of the topic women entrepreneurs in STEM



Source: **VOSViewer** from **SCOPUS** keywords

Graph 8. Evolution of co-words of the theme women entrepreneurs in biotech



Source: **VOSViewer** from **SCOPUS** keywords

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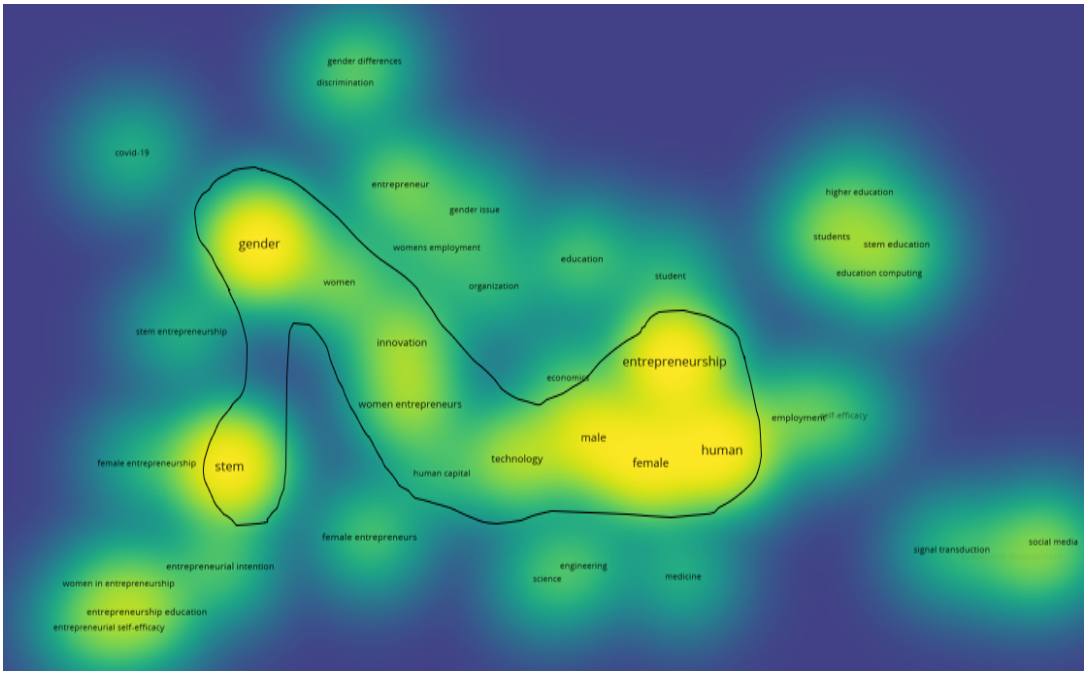
5.3.3. Bibliometric density map

The bibliometric density map provides the different areas of research classified by the intensity and their level of relevance (Calzado, et al, 2019). The **SCOPUS** database of the theme of women entrepreneurs in **STEM** highlights the core of: gender, stem, female, human, and, entrepreneurship. The theme of women entrepreneurs in biotech emphasizes: humans, and biotechnology. Although in both the word entrepreneurship is highlighted, only in the first topic is gender given a greater relevance. This is because is a male-dominated field that remains mostly gendered masculine even though there is a higher percentage of women scientists (Treanor & Marlow, 2021). (See **Graphs 9 and 10**).

Graph 9. Bibliometric density map of the topic of women entrepreneurs in STEM



Source: **VOSViewer** from **SCOPUS** keywords

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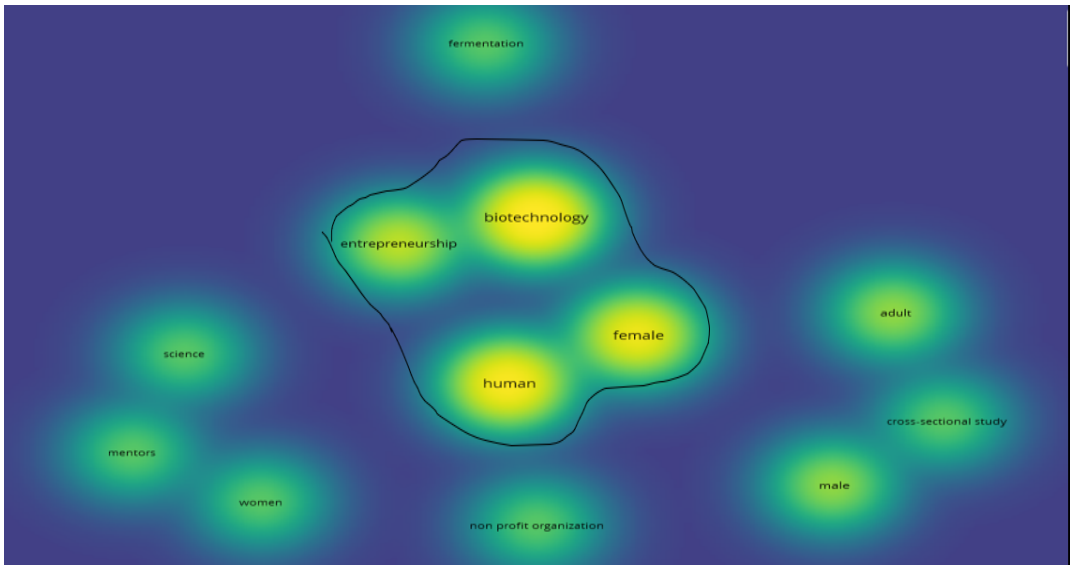
Graph 10: Bibliometric density map of the topic of women entrepreneurs in biotech



Source: **VOSViewer** from **SCOPUS** keywords

6. DISCUSSION

The discussion section delves into the crucial topic of women's representation in biotechnology entrepreneurship, aligning with the journal's emphasis on transdisciplinarity and sustainable innovation. The analysis reveals a persistent underrepresentation of women in this field despite a recent uptick in publications on the subject (Lofstrom & Bates, 2017). The current state of research underscores a significant gap in the number of women entrepreneurs in biotechnology compared to other **STEM** fields, highlighting the need for focused attention.

The most cited articles pinpoint women entrepreneurs' barriers and challenges in biotechnology, emphasizing the necessity for policies supporting their success (Budde-Sung, 2019). While progress has been made, gender disparities endure, necessitating further research to understand and address the root causes (Park & Yoon, 2020). This effectively communicates the ongoing nature of these disparities, emphasizing the urgency for intervention.

Policy implications, such as improving access to funding and mentorship, are discussed as key strategies to promote women's entrepreneurship in biotechnology (Shane & Venkataraman, 2019). In summary, the discussion synthesizes the analysis findings and calls for continued research and targeted policies to bridge the gender gap in biotechnology entrepreneurship, aligning with the journal's overarching theme of transdisciplinarity and sustainable innovation.

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6.1.Theoretical implications (*Scientia*)

Informed by the nuanced exploration of women's entrepreneurship in **STEM** and **Bio-MedTech**, this section delves into the theoretical ramifications of the transdisciplinary and sustainable innovation framework. Rooted in the contextual understanding derived from the literature review, the study unfolds novel connections between various elements, including societal roles, access to finance, and business management challenges (Guzman & Kacperczyk, 2019).

The proposed theoretical framework not only elucidates existing factors and variables but also forges novel relationships among them. By dissecting the gender-socialized belief system, barriers in business management, and the unique challenges faced by women entrepreneurs in **Bio-MedTech**, the study transcends disciplinary boundaries, hinting at the potential formation of new interdisciplinary domains (NWBC, 2021).

The transdisciplinary nature of the study not only connects diverse scientific disciplines but also suggests the emergence of innovative paradigms. The interconnected elements, ranging from skill sets to societal roles, lay the groundwork for holistic strategies promoting women's entrepreneurship (Shane & Venkataraman, 2019). This synthesis of factors holds implications not only for scientific disciplines but also for societal and environmental dimensions. In sustainable innovation, the study addresses barriers hindering women's participation in scientific businesses, contributing to a more inclusive entrepreneurial landscape (Hill et al., 2017). The theoretical implications extend to circular economy, societal impact, and environmental sustainability, offering a blueprint for a more equitable and innovative future (Budde-Sung, 2019).

In summary, the theoretical implications highlight the transformative potential of a transdisciplinary and sustainably innovative approach, offering insights that contribute to existing knowledge and envisioning the formation of new scientific disciplines and practices (Sirt, 2019). This exploration sets the stage for a more equitable, inclusive, and innovative trajectory in **Bio-MedTech** entrepreneurship.

6.2.Practical implications (*Praxis*)

Grounded in the contextual examination of women's entrepreneurship in **STEM** and biotechnology across global and national levels, the practical implications underscore the necessity for a nuanced approach to foster increased entrepreneurial activity among women. The prevailing notion that

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boosting female enrollment in **STEM** fields will automatically translate into heightened entrepreneurial engagement faces a significant challenge in biotechnology, where a notable percentage of women study, yet fewer venture into entrepreneurship (Surdez, 2020). To address this, it is imperative to move beyond the simplistic assumption and focus on tailored programs within academic settings.

Recognizing that female entrepreneurship entails more than developing hard skills, the practical implications advocate for a holistic approach. As articulated by DeLong & Elbeck (2018), this approach involves not only the enhancement of technical procedures but also the cultivation of interpersonal and behavioral skills. Attention must be directed towards internal aspects, emphasizing the importance of soft skills, and external aspects, addressing societal roles and strategies to overcome associated barriers. Such multifaceted skill development is deemed crucial for both **STEM** and biotechnology industries, where women face similar challenges leading to a low percentage of entrepreneurs (Surdez, 2020).

On a broader scale, the practical implications highlight the need for increased research focus on women entrepreneurs in **STEM** and biotechnology. The observed difference in research emphasis suggests a potential gap in understanding the unique challenges faced by women in these fields. The comprehensive exploration of the intricate dynamics surrounding women's entrepreneurship is essential, taking into account societal perceptions, educational systems, and industry-specific challenges. This understanding informs the development of effective policies and interventions, promoting inclusivity and equitable opportunities for women in entrepreneurship. The practical implications extend to technological advancements, social groups, and environmental considerations, emphasizing the transformative potential of a nuanced approach in fostering gender-inclusive entrepreneurship.

7. CONCLUSION

Our research concludes in:

7.1 Answering the question and explaining the research hypotheses

The research question centered on the importance researchers attribute to women entrepreneurs in **STEM** and the disparities in interest regarding women entrepreneurs in biotech, utilizing the

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SCOPUS platform. The hypothesis suggested that an increase in female **STEM** enrollment may not proportionally elevate the percentage of female entrepreneurs, especially within the biotech industry. The findings confirm that, despite a surge in relevance in 2022, information on women entrepreneurs in **STEM** and biotech remains incipient and is largely confined to a single country. Notably, no discernible patterns indicate leading authors or research groups in these areas, presenting an opportune space for further exploration.

7.2 Research findings

The bibliometric analysis and literature review underscore several key practical implications for encouraging women's entrepreneurship in **STEM** and biotech. Firstly, there's a need for gender-sensitive business education, focusing on skill development, identity, and mentorship (Armuña et al., 2020). Secondly, achieving entrepreneurial belonging for women in **STEM** necessitates reconciling gender expectations in a masculinized context (Birkner, 2020). Lastly, fostering gender balance in **STEM** ventures, especially within teams, enhances team dynamics and performance (Neumeyer & Santos, 2020). These findings contribute theoretically (Scientia) and practically (Praxis) to the state-of-the-art and environmental context, emphasizing the necessity of holistic approaches to address gender disparities in entrepreneurial endeavors.

7.3 Research final scope

In concluding this research, it is imperative to acknowledge the study's limitations. The data, while insightful, predominantly reflects a singular country's perspective, limiting generalizability. Additionally, the absence of discernible patterns in research groups or leading authors underscores this field's nascent stage, presenting challenges and opportunities for future investigations. Future studies should aim to broaden the geographical scope and incorporate diverse perspectives to enhance the robustness of the findings. Despite these limitations, this research serves as a foundational exploration, paving the way for transdisciplinary and sustainable innovation-focused studies that can drive inclusivity and equitable opportunities for women in **STEM** and biotechnology entrepreneurship.

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