Representation of “Women” in Science and Field

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Abstract: Women's studies continue in various fields within the framework of the 2030 Sustainable Development Goals, following the Millennium Development Goals. Assessing women's participation in innovation and creative activities reveals their underrepresentation in these domains. Studies in the literature predominantly focus on either the outcomes or the processes of this issue. The aim of this study, however, is to shed light on the root causes of the problem. This study utilized bibliometric methods to analyze 1,995 articles retrieved from the Web of Science (WOS) database, selecting "women" or "woman" as the research area, based on the concepts of socially constructed scientific knowledge and language's fundamental role in institutional reality. We adopted both a linguistic and theoretical perspective in this context, and utilized secondary data from WIPO statistics that indicated patent application numbers in the sector. The analysis results underline the need for a shift in institutional logic, and this institutional perspective offers a new dimension to the limited research in this field.

Keywords: Innovation, Creativity, Intellectual Property, Women, Institutionalization

1. Introduction

Women's studies, which play a critical role in achieving the United Nations Millennium Development Goals, continue within the framework of the 2030 Development Agenda. According to the 2022 UN Sustainable Development Report, efforts to achieve gender equality have increased over the past seven years; however, these efforts are still considered insufficient.

A review of the literature reveals numerous studies highlighting the socioeconomic (Vyas-Doorgapersad, 2023; Hosen et al., 2024), cultural, social (Franco et al., 2020; Dasgupta, 2023), institutional, and political (Jeevanasai et al., 2023; Khan et al., 2024) challenges women face in achieving the goal of gender equality. Despite these extensive efforts, it is believed that the inability to reach the desired levels is due to a failure to address the root causes of the issue. While reports and statistics focus on outcomes, and academic studies emphasize processes, neither adequately addresses the fundamental causes of the problem.

This study aims to shed light on the underlying reasons why, despite significant efforts, gender equality remains elusive. Two main pillars structure the research: the sectoral and the academic. Sectoral evaluations rely on patent data, a type of intellectual property, as it provides extensive data in this area and serves as a key indicator of participation in innovative activities (Singh et al., 2022). In this context, the study's research question aims to understand why women's participation in innovative and creative activities remains insufficient, despite the existence of numerous studies on women over the years.

2. Literature Review

Women's participation in innovation and creative activities is crucial for fostering diverse perspectives and driving economic growth. From a sectoral perspective, gender diversity in innovation not only contributes to more inclusive and equitable workplaces but also leads to improved scientific and commercial outcomes. Such participation is essential to fully harness the workforce's potential and ensure that innovation reflects the needs and experiences of the entire population (Capozza and Divella, 2024). Despite this, women continue to face significant barriers in innovation sectors, including patent-related activities (Medina and Álvarez, 2022).

According to European Union data, only 32.8% of employees in innovation and technology sectors are women (Eurostat, 2022). Similarly, data from the US Patent and Trademark Office (2020) indicate that only 12.49% of inventor patent holders are women. Investigating how intellectual property rights impact women's roles in creative processes and their contributions to economic development is a critical step toward reducing gender inequalities, ultimately enhancing societal welfare in the long term (Hirsch, 1943; Tritton, 1996; Dixon & Greenhalgh, 2002; Bainbridge, 2018).

The World Intellectual Property Organization (WIPO, 2020) recognizes intellectual property as a system that drives innovation and creativity. According to WIPO (2023) data, innovators worldwide filed 3.46 million patent applications, representing a 1.7% increase compared to 2021. However, the share of female inventors remains

below 18% globally (WIPO, 2023). WIPO, 2020 categorizes intellectual property rights into two main types: industrial property rights and copyrights. This study focuses on patent data, classified under industrial property rights and highlighted in the WIPO 2023 report, due to the extensive availability of patent data globally.

Figure 1 illustrates the proportion of female inventors among the top 25% of countries ranked by the number of patents granted by the US Patent and Trademark Office in 2020. Even in Taiwan, which has the highest proportion, women account for only 32.2% of inventors. This starkly highlights the significant gender disparity in patent activities (Muir et al., 2022).

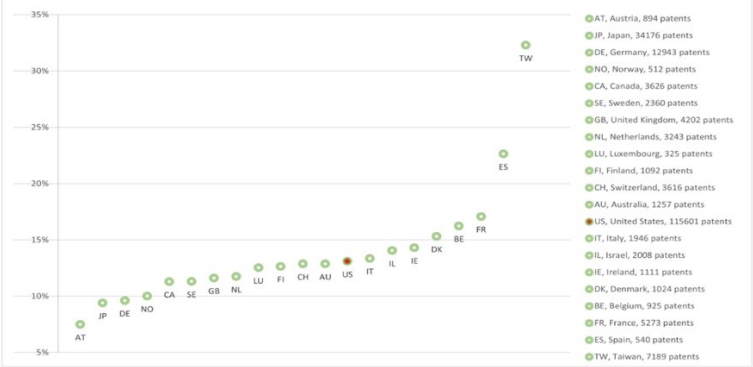

Figure 1: Women's inventor rate (WIR) of top %25 assignee countries in 2020

Research demonstrates that gender-inclusive policies can foster a culture of innovation, particularly when the proportion of women in R&D roles increases (Lee and Jung, 2024). Gender diversity in corporate boards positively influences innovation activities, as evidenced by increased R&D expenditures and patent filings in firms with female executives (Adams et al., 2023). The gender composition within teams is strongly associated with enhanced innovation and performance. Teams that prioritize gender equality bring diverse perspectives and ideas, leading to more creative solutions and better decision-making processes (Hemmert et al., 2022; Ezeugwa et al., 2024). Additionally, they contribute significantly to innovation by introducing unique viewpoints and approaches to problem-solving (Badilescu and Packirisamy, 2022; Kumar and Shobana, 2023). These findings underscore the importance of promoting gender equality as a critical factor in driving innovation and fostering progress.

From an economic development perspective, women's participation in entrepreneurship and innovation is crucial as it fosters creativity and the establishment of new businesses. However, women face numerous challenges, including gender bias and limited access to resources, which hinder their innovative potential (Schneider, 2017; Kurmankulov et al., 2023; Veckalne and Tambovceva, 2023). Overcoming these barriers significantly contributes to economic growth (Altuzarra et al., 2020; Singh et al., 2022). For instance, increasing the number of female inventors involved in patents could boost the U.S. GDP by up to $1 trillion annually (Fechner et al., 2022). Similarly, the Japanese government has set a goal for women to hold 30% of decision-making roles, recognizing this as a critical strategy for economic growth (Nakazawa and Akabayashi, 2022).

Empowering women in innovation not only benefits the economy but also promotes a more equitable and resilient society by challenging traditional gender norms (Berglund and Pettersson, 2021; Gallego and Maestripieri, 2022). Creativity, as a socio-cultural process, involves the integration of new works into existing cultural systems, highlighting women's roles in cultural participation and transformation. Women's creativity represents a form of engagement that contributes to the evolution of culture, playing a vital role in producing and transmitting new cultural artifacts essential for societal progress (Glaveanu, 2011). The recognition of women's roles in innovation and technology marks a shift toward more inclusive cultural landscapes, reflecting broader societal changes and fostering a more diverse cultural narrative (Eisler and Montuori, 2007).

3. Methodology

On October 2, 2024, we retrieved the data for this study from the Web of Science (WoS) database. WoS is a widely used source for bibliometric analyses due to its high-quality standards and comprehensive metadata, including titles, abstracts, keywords, and references (Netter et al., 2009; Caroline et al., 2020; Mumu et al., 2022). Bibliometric analysis is a method that enables us to understand the intellectual and conceptual context of the literature. By analyzing common keywords, citations, authorship relationships, and country trends, it uncovers implicit meanings, themes, and connections within academic works. This approach provides a

comprehensive framework for understanding knowledge flow, academic collaborations, and interdisciplinary relationships in the literature, offering valuable insights into the research field (Linnenluecke et al., 2019; Ghosh, 2024).

The bibliometric analysis was conducted using the Biblioshiny interface within the R Bibliometrix package (Aria and Cuccurullo, 2017). Data downloaded from the Web of Science (WoS) in BibTeX format were imported into the R program. An initial search using the keywords "Woman" OR "Women" in "All Fields" yielded 2,225,975 records. After filtering for the 2019–2023 period, 629,099 studies were selected. Further refinement was made by focusing on "English," "Open Access," "Article," and the categories of "Business" and "Management." Publications from 2024 and other categories were excluded from the analysis. Finally, out of 2,312 articles, 317 studies were excluded as they did not align with the research objectives, resulting in the analysis being conducted on a final dataset of 1,995 articles. Figure 2 below illustrates the data extraction procedures used to determine the final sample.

Figure 2: Data extraction steps

4. Findings

Performance analysis is a fundamental feature of bibliometric studies (Alam et al., 2021; Donthu et al., 2021). In this section, using the dataset obtained from WoS in October 2024, descriptive analysis results are presented for variables such as the most relevant journals, the most productive countries, and the most frequently used keywords.

Table 1: Main Information about data

Description	Results
Timespan	2019:2023
Sources (Journals, Books, etc)	388
Documents	1995
Annual Growth Rate %	16.35
Document Average Age	2.67
Average citations per doc	14.43
Document Contents	**Results**
Keywords Plus (ID)	3263
Author's Keywords (DE)	5842
Authors	**Results**
Authors	5467
Authors of single-authored docs	244

Description	Results
Authors Collaboration	**Results**
Single-authored docs	260
Co-Authors per Doc	3.15
International co-authorships %	35.99
Document Types	
Article	1995

As shown in Table 1, the results indicate that the dataset includes 1,995 articles, all published between 2019 and 2023. A total of 5,467 authors contributed to the research field, 244 of whom published articles as sole authors. The rate of international collaboration among authors is 35.99%, highlighting the significant level of global cooperation among researchers in this area.

Table 2: The top 5 journals with the highest frequency of the keyword's "women" and "woman"

Name of Journal List	F
Gender Work and Organization	277
Cogent Business & Management	63
Administrative Sciences	58
Gender In Management	47
Equality Diversity and Inclusion	28

As indicated in Table 2, these articles were published across 388 journals. The top five journals with the highest frequency of publications are Gender, Work and Organization (277 articles), Cogent Business & Management (63 articles), Administrative Sciences (58 articles), Gender in Management (47 articles), and Equality, Diversity, and Inclusion (28 articles).

Table 3: Countries' Scientific Production

Row	Region	F	Row	Region	F
1	UK	1365	21	Finland	83
2	USA	799	22	Portugal	81
3	Spain	369	23	Denmark	65
4	Australia	320	24	Saudi Arabia	60
5	Italy	247	25	Slovakia	60
6	Brazil	240	26	New Zealand	59
7	Germany	222	27	Switzerland	57
8	Pakistan	216	28	Nigeria	55
9	Canada	205	29	Austria	54
10	France	200	30	Czech Republic	50
11	Netherlands	187	31	Belgium	49
12	China	176	32	Colombia	48
13	Sweden	174	33	Turkey	48
14	India	166	34	South Korea	41
15	Ireland	130	35	Egypt	39
16	Malaysia	113	36	Vietnam	38
17	South Africa	108	37	Bahrain	34
18	Indonesia	102	38	Russia	34
19	Norway	93	39	Lithuania	33
20	Poland	84	40	Mexico	32

Table 3 presents the top 40 countries contributing the most to the research field. According to the table, the most productive country is the United Kingdom, with 1,365 articles, followed by the USA with 799 articles. Spain ranks third, having published 369 articles.

Table 4: List of most frequent words

Row	Words	F	Weighted (%)	Row	Words	F	Weighted (%)
1	Women	578	17,71	21	Experiences	62	1,90
2	Gender	424	12,99	22	Corporate Social Responsibility	61	1,87
3	Impact	268	8,21	23	Female	60	1,84
4	Performance	243	7,45	24	Gender Diversity	59	1,81
5	Work	234	7,17	25	Attitudes	58	1,78
6	Management	174	5,33	**26**	**Family**	**58**	**1,78**
7	Diversity	131	4,01	27	Race	58	1,78
8	Firm Performance	94	2,88	28	Entrepreneurship	57	1,75
9	Business	92	2,82	29	Organizations	57	1,75
10	Men	88	2,70	30	Ownership	57	1,75
11	Directors	86	2,64	**124**	**Family Conflict**	**19**	**0,58**
12	Leadership	86	2,64	**181**	**Home**	**13**	**0,40**
13	Governance	84	2,57	**212**	**Motherhood**	**11**	**0,34**
14	Perceptions	84	2,57	**237**	**Mothers**	**10**	**0,31**
15	Gender-Differences	81	2,48	**254**	**Children**	**9**	**0,28**
16	Behaviour	76	2,33	**266**	**Sex-Role Stereotypes**	**9**	**0,28**
17	Identity	75	2,30	**275**	**Child-Care**	**8**	**0,25**
18	Model	74	2,27	**278**	**Creativity**	**8**	**0,25**
19	Determinants	68	2,08	**527**	**Housework**	**4**	**0,12**

Row	Words	F	Weighted (%)	Row	Words	F	Weighted (%)
20	Employment	63	1,93	**2216**	**Intellectual Property**	**1**	**0,03**

Table 4 lists the 30 most frequently encountered words in studies related to "women" or "woman." The continuation of the table includes additional words of interest, relevant to the research question, for further exploration.

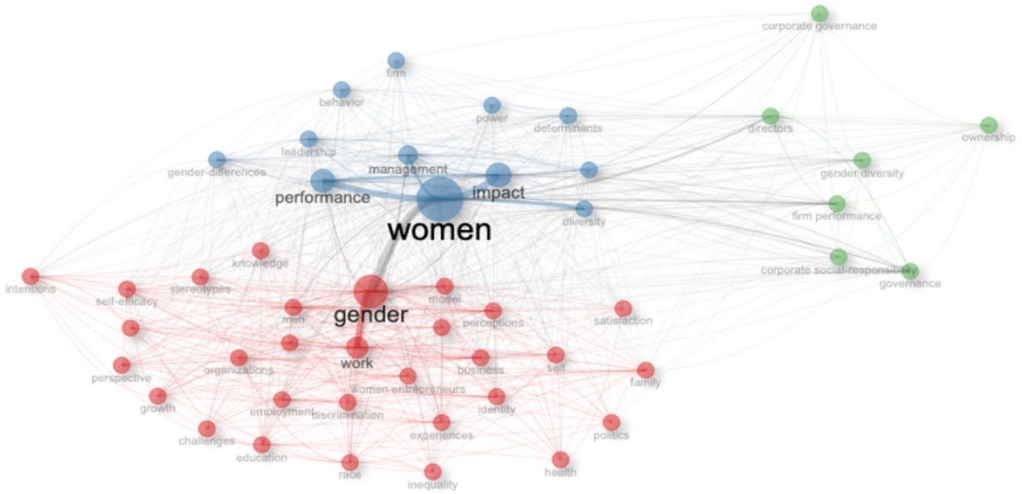

Figure 3: Co-word analysis map

Researchers use co-word analysis (Callon et al., 1983) to identify dominant themes and research trends within a field (Whittaker, 1989; Wider et al., 2023). The distance between terms on the co-word map indicates the relationship between these terms (Gürol et al., 2024). In other words, keywords that frequently appear together in the same documents are connected, assuming that co-occurring words have a thematic relationship (Khassesh et al., 2021; Pourhatami et al., 2021; Rohani and Makkizadeh, 2022). Keywords enable researchers to identify the conceptual structure of a discipline without the need to refer to the full text of articles (Uyar et al., 2020), providing a deeper understanding of the discipline's intellectual framework (Zhu and Zhang, 2020; Smith, 2021). The visualization of these findings reveals the interactions between terms (Dutta, 2013). The co-word analysis mapping results indicate the formation of three clusters. The term women dominates the blue cluster, while the red cluster emphasizes gender. In contrast, the third cluster does not exhibit any specific concentration or dominant term.

5. Conclusion

Academic developments have led to an increase in the number of scholarly studies focusing on women. As a contribution to the literature, this study analyzed articles on women retrieved from the Web of Science (WOS) database. Given the limited time remaining to achieve the sustainability goals, this research focuses on women in alignment with the Sustainable Development Goals (SDGs) 5. Participation in innovation and creative activities is crucial for fostering diverse perspectives. The convergence of different ideas encourages the emergence of new concepts and drives economic growth. Therefore, including women in these processes not only enhances creativity but also accelerates development.

Between 2019 and 2023, women's studies have increased significantly; however, women have not achieved the desired position in terms of gender equality. This study examines the role of women in the sector through the lens of patent numbers. Accordingly, the word analysis focused on terms related to "creativity," "innovation," and "intellectual property" in alignment with patents. The findings in Table 4 show the frequency of these terms as follows: *creativity* (8), *intellectual property* (1), and *innovation* (0). On the other hand, terms related to family and domestic responsibilities, such as "family", "family conflict", "home", "motherhood", "mothers", "children", "sex-role stereotypes", "child care", and "housework", were more frequently used. The "business" and "management" filters used in the research make these findings significant. They also reinforce the idea that women's low number of patent applications stems from their disproportionate focus on familial and domestic roles, underscoring significant barriers to their participation in innovation-driven sectors.

While our primary goal was to understand the arguments presented in the literature on women, we adhered to the theory that language serves as the primary tool for the social construction of scientific knowledge (Berger and Luckmann, 1966) and institutional reality (Searle, 1995). Astley and Hawkins (1985) assert that members of a scientific community, who develop their own "systems of words," essentially compose scientific fields. Nag et al. (2007) contend that language serves as a tool for academic discipline participants to articulate their concepts, thereby determining the implicit definition or inherent nature of the field. In this context, the analysis results reveal that terms related to women's social roles (*family*, *family conflict*, *home*, *motherhood*, *mothers*, *children*, *sex-role stereotypes*, *child care, and housework*) appear more frequently than terms like *creativity*, *intellectual property*, and *innovation*. This suggests that the language used reinforces an institutional logic that perpetuates traditional social roles for women, rather than supporting their desired position in innovation and creativity. Cultural beliefs or rules, known as institutional logics, guide actors' decisions and behaviors, explaining institutional change (Bourdieu, 1990; Friedland and Alford, 1991; Lounsbury, 2007). Therefore, unless the institutional logic regarding "women" shifts, no matter how much the number of studies increases, the desired goals will not be achieved. In other words, unless "creativity" and "innovation" come to mind before social gender roles (e.g., motherhood, housework) when discussing women, their participation in creative activities will not reach the desired level. In conclusion, the goals and institutional logic must coincide.

In conclusion, the literature has addressed the social, cultural, cognitive, and economic barriers women face in innovative and creative activities separately. This study, however, adopts a holistic perspective by proposing a solution based on a shift in institutional logic, pointing to a more macro-level approach. It is argued that to enhance women's roles in innovation and creative activities, institutional logic must first be transformed. Considering the mediating role of language in this process, studies on women should use terms like "creativity," "innovation," and "technology" instead of "family," "family conflict," "home," "motherhood," "mother," "children," or "child-care." This linguistic shift can help reinforce institutional logic in favor of women's participation in innovation and creativity. Women may not have reached the desired level in these areas for a variety of reasons, but one of the key determinants underlying these reasons is the institutional structuring of

women's roles. Language acts as an intermediary in this institutionalization process, making it crucial to frame women's roles with words such as "creativity," "innovation," and "technology."

This study has several limitations. First, bibliometric analysis itself can be considered a limitation. While it enables researchers to uncover the unseen by relying on data from studies conducted within a specific field and time frame, interpreting the results and discovering the unseen requires researchers to have a strong understanding of the topic and to supplement bibliometric findings with content analysis when necessary. Another limitation of the study is the exclusive use of the Web of Science (WoS) database for data collection. This choice was made because WoS includes high-standard publications. Additionally, the use of only the keywords "Women" and "Woman" is another limitation. Future studies could employ different keywords, and alternative methodologies such as meta-analysis or systematic literature reviews could further develop the findings. Finally, the research question was approached from the perspective of institutional construction, the role of language in this process, and institutional logic. However, it is also possible to explore the issue from other theoretical perspectives.

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