

International Conference

Women in Science

Empowering
Inclusive Futures

Proceedings

February 11-12, 2026
Mykolas Romeris University
Vilnius, Lithuania

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Conference:*
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Women in Science International Conference 2026: Proceedings

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and Ana León-Manzanero

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Conference Description

The conference took place in **Vilnius (Lithuania)**, at the premises of Mykolas Romeris University (Ateities g. 20 and Didlaukio g. 55), on **February 11–12, 2026**, in connection with the celebration of the **International Day of Women and Girls in Science**.

The event was held **primarily in an in-person format** and brought together **scientists, institutions, members of the academic community, policymakers, and society** at large. The conference was **open-access and free of charge**, reinforcing its commitment to making scientific knowledge accessible beyond academic settings and fostering dialogue between science and society.

Researchers from 18 countries participated in the conference, contributing to interdisciplinary dialogue. **Authors from more than 20 universities** and research centers presented their scientific work. The present volume includes **a selection of papers** based on contributions presented at the conference.

Cultural diversity was fostered through a strong commitment to **multilingualism in science**. While **English served as the official language**, participants were allowed to submit abstracts in an additional language of their choice, enabling them to reflect their cultural identity or a language closely connected to their research. This resulted in a **Book of Abstracts featuring texts in 11 languages**: Dutch, English, German, Italian, Lithuanian, Macedonian, Nigerian Pidgin, Spanish, Swahili, Turkish, and Urdu. The Book of Abstracts is available online at <https://doi.org/10.13165/9786094881244>

Furthermore, the program included **a parallel session in Lithuanian and another in Spanish**, reflecting the languages of the two organizing institutions. In line with its inclusive approach, **two hybrid sessions** were organized to facilitate participation for scholars facing mobility or travel constraints.

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Institutional Framework

The Women in Science International Conference 2026 was organized by **Mykolas Romeris University** and **ACEBaltic**, the **Association of Spanish Scientists in the Baltic Countries**.

With the support of **EWORA**, the **European Women Rectors Association**, the **Embassy of Spain in Lithuania**, and the **Ramón Areces Foundation**.

The conference was held under the honorary patronage of the **Prime Minister of Lithuania, Inga Ruginienė**, underscoring the public and political relevance of gender equality in science.



The Women in Science International Conference 2026 originated within the framework of the **Post-digital Storytelling for Gender Equality (PSGENEQ) Research Project**.

It was organized as part of a project funded by the State Budget titled “Establishment of Centers of Excellence at Mykolas Romeris University”, which is implemented under the “Centers of Excellence Initiative” led by the Ministry of Education, Science and Sports of the Republic of Lithuania.

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Epistemic Algorithmic Drift: AI-Mediated Scholarly Infrastructures and the Reproduction of Gendered and Intersectional Inequalities

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Abstract: Artificial intelligence is reshaping scientific knowledge production in ways that risk reinforcing existing inequalities. This article introduces the concept of *epistemic algorithmic drift* to explain how AI-mediated scholarly infrastructures, trained on historically stratified data, generate cumulative and often imperceptible redistributions of epistemic visibility, amplifying gendered, linguistic, and geographic disparities.

The contribution is theory-building: drawing on feminist epistemology, intersectionality theory, and critical algorithm studies, it conceptualizes drift as a self-reinforcing feedback loop between structured data and AI-mediated processes of discovery, evaluation, and recognition. In doing so, it distinguishes epistemic algorithmic drift from related notions such as algorithmic bias, concept drift, and path dependency.

The article specifies empirically observable indicators, examines the process through an intersectionally informed perspective, and derives governance considerations grounded in its structural dynamics. It argues that addressing these inequalities requires longitudinal, intersectional, and infrastructural interventions rather than isolated technical fixes.

Keywords: Artificial intelligence; algorithmic bias; gender inequality; scientific publishing; epistemic infrastructures; intersectionality; cumulative advantage; feminist epistemology.

Introduction

In recent years, artificial intelligence (AI) has shifted from the margins to the core of scientific practice, evolving from a set of auxiliary tools into a more deeply embedded component of knowledge production (Amayreh & Amayreh, 2025; Eren & Perez, 2025). This transition signals a broader transformation: not simply the adoption of new technologies, but their integration into the very processes through which scientific value is assigned and recognition distributed.

Central to this shift is the growing role of machine learning systems in mediating key decision-making processes within academic publishing and research evaluation. These systems shape which papers are encountered in literature searches, how manuscripts are screened and routed through peer review, and how research proposals are assessed and ranked (Beel et al., 2016; Heaven, 2018; Kousha & Thelwall, 2024; Lund et al., 2024). In doing so, AI does

not merely support scientific activity but actively shapes its trajectories. Yet the functioning and criteria of these systems remain only partially transparent, even to the institutions that rely on them.

From a feminist perspective on knowledge production, this reconfiguration concerns the conditions under which epistemic authority is produced and distributed. Within this framework, Sandra Harding (1986, 1991) reconceptualizes objectivity as situated, arguing that “strong objectivity” requires explicit recognition of the social position of the knower. Building on this shift, Helen Longino (1990, 2002) locates scientific validity in structured processes of critical interaction rather than individual methodological rigor alone. Extending this critique, Donna Haraway (1988) challenges the illusion of a neutral “view from nowhere,” showing how claims to objectivity obscure their own partiality, while Lorraine Code (1991) emphasizes that epistemic authority circulates within socially organized practices of credibility. Taken together, these contributions establish that AI cannot be understood as a neutral enhancement of scientific practice: it functions as a socio-technical mediator embedded in existing structures of power.

This argument gains further force when situated within Kimberlé Crenshaw’s (1989, 1991) concept of *intersectionality*, which shows how categories such as gender, race, and class operate as interlocking systems with irreducible effects, and Patricia Hill Collins’s (1990) notion of a *matrix of domination*, which highlights the mutually reinforcing nature of institutional and discursive power. Applied to AI-mediated systems, this perspective suggests that their effects are neither neutral nor uniform: the organization of visibility, evaluation, and recognition is shaped by linguistic, geographic, and positional inequalities, which are both reflected and reinforced through algorithmic processes.

Against this background, mechanisms of cumulative advantage in science acquire renewed relevance, as Robert K. Merton (1968) showed in his formulation of the Matthew effect, whereby recognition tends to concentrate around already established scholars. Within this framework, Margaret W. Rossiter (1993) identified its gendered counterpart, the Matilda effect, naming the systematic undervaluation and misattribution of women’s scientific contributions. These dynamics are not merely theoretical but are consistently supported by empirical evidence: large-scale bibliometric analyses show that publications authored by women receive fewer citations than comparable work by men across most scientific fields (Larivière et al., 2013); a landmark peer review study found that female applicants required significantly stronger publication records to receive equivalent evaluation scores (Wennerås & Wold, 1997); and more recent work confirms that disparities accumulate over time, shaping trajectories of visibility and contributing to the persistent underrepresentation of women among the most highly cited scholars (Huang et al., 2020; King et al., 2017).

Thus, the growing integration of AI-mediated systems reshapes the conditions under which inequality is reproduced. Systems trained on historically stratified data risk encoding and amplifying existing disparities, while their opacity makes these processes less visible and more difficult to

contest — a shift from socially mediated to infrastructurally embedded forms of cumulative disadvantage.

To account for this shift, the concept of epistemic algorithmic drift is introduced, capturing the process through which pre-existing inequalities, once mediated by AI-driven scholarly infrastructures, are translated into cumulative and often imperceptible redistributions of visibility, recognition, and epistemic authority. The aim is to move from naming an emerging phenomenon to specifying its generative mechanism, to distinguish it from adjacent notions, and to identify empirically observable indicators through which it can be analyzed.

This analytical orientation defines the nature of the contribution: the article develops a conceptual framework grounded in a theoretically informed narrative review of existing research, with the aim of specifying a generative mechanism and deriving analytically grounded governance implications.

On this basis, the argument unfolds across four interconnected movements. The first examines the infrastructural role of AI in scholarly communication, focusing on the forms of epistemic filtering through which visibility and relevance are algorithmically organized. The second considers the unequal conditions under which AI integration unfolds across the research community. The third develops the concept of epistemic algorithmic drift itself, outlining its analytical dimensions, intersectional implications, and empirically observable indicators. The fourth derives governance considerations from the structural analysis, distinguishing between responses adequate to drift and those that address only its symptoms.

Methodological Note and Analytical Positioning

The analysis combines conceptual synthesis with a theoretically informed narrative review of recent empirical research on artificial intelligence in academic work and scientific publishing. Rather than aiming at exhaustive coverage, the review seeks to identify recurring mechanisms through which AI-mediated systems interact with existing inequalities in knowledge production, with a specific focus on gender as a relational and intersectional dimension.

The literature search was conducted between November 2025 and January 2026 using Scopus, Web of Science, and Google Scholar, combining terms related to artificial intelligence, scholarly communication, and inequality in Boolean configurations¹. In addition, forward citation tracking was conducted on key contributions in feminist epistemology, intersectionality theory, and critical algorithm studies. The corpus was supplemented by foundational studies on gender disparities in peer review and citation practices, and by

¹ The Boolean search string was constructed as follows: ("artificial intelligence" OR "machine learning" OR "generative AI") AND ("academic publishing" OR "scholarly communication" OR "peer review" OR "research evaluation") AND ("gender" OR "women" OR "gender inequality" OR "gender disparities" OR "intersectionality" OR "algorithmic bias").

selected theoretical works necessary to situate the proposed concept within adjacent sociological and STS frameworks.

The initial search yielded approximately 160 records across the three databases. After duplicate removal, the remaining records were screened in two stages (title/abstract screening followed by full-text assessment). The final corpus includes 32 sources: peer-reviewed journal articles, books and book chapters, and a limited number of reports or preprints addressing recent developments not yet consolidated in the peer-reviewed literature.

The distribution of results varied across platforms. Scopus and Web of Science returned the majority of peer-reviewed articles in social sciences and science and technology studies. Google Scholar contributed additional materials, including book chapters, interdisciplinary contributions, and recent preprints. Purely technical papers focused exclusively on model performance, as well as opinion pieces lacking explicit analytical grounding, were excluded unless directly relevant to AI-mediated scholarly practices.

Selection was guided by three criteria: (1) relevance to the role of AI in mediating visibility, evaluation, and participation in knowledge production; (2) sufficient methodological transparency, understood as the explicit description of data sources, research design, or analytical procedures allowing assessment of evidential robustness; and (3) coverage across disciplinary perspectives, including social sciences, STS, and computer science. Studies were excluded if they addressed AI in contexts unrelated to academic knowledge production, lacked minimal methodological specification, or did not provide implications for scholarly practice or epistemic inequality.

The review adopts a comparative interpretive approach rather than quantitative aggregation. Several limitations are acknowledged. Industry sources are used cautiously, as indicative of broader distributional patterns rather than as primary evidence, and preprints are included selectively to capture emerging developments while remaining analytically qualified throughout. The uneven availability of gender-disaggregated empirical data on AI in academic contexts limits the precision with which intersectional dynamics can be reconstructed. This constraint is not only empirical but analytically relevant, as it contributes to the limited observability of the processes under investigation.

Accordingly, the article adopts intersectionality as an analytical orientation rather than as a fully operationalized empirical design: while gender, geography, language, career stage, and institutional position can be specified as relevant dimensions of exposure to drift, the available literature does not yet allow systematic analysis of their intersections with racialized forms of inequality across scholarly infrastructures.

A further limitation concerns the epistemological status of the concept introduced here. Epistemic algorithmic drift is proposed as a theoretical construct supported indirectly by evidence on its constituent mechanisms (historically stratified data, algorithmic amplification of visibility), and unequal conditions of AI adoption, rather than directly demonstrated as a fully observable process. Establishing it empirically would require longitudinal,

disaggregated data linking AI system deployment to changes in visibility and evaluation patterns within specific scholarly infrastructures. While partial datasets exist across bibliometric archives and editorial systems, they remain fragmented, unevenly accessible, and not yet available in integrated forms that would allow robust, intersectionally disaggregated analysis of these dynamics. This paper therefore contributes by specifying the mechanism in analytically explicit terms, enabling its future empirical investigation.

Epistemic Infrastructures and Algorithmic Mediation

AI systems increasingly function as epistemic infrastructures within scholarly communication, shaping not only what becomes accessible but also the conditions under which it is encountered. As Susan Leigh Star (1999) observed, infrastructures are not neutral supports; they are relational arrangements that embed standards, classifications, and conventions. In doing so, they actively configure what can be known, even as they remain largely taken for granted. Indeed, their relative invisibility is not incidental but constitutive of their power, allowing them to organize epistemic processes while remaining only partially accessible to scrutiny.

Within this infrastructural configuration, the growing reliance on measurable proxies, such as citation counts, publication frequency, institutional prestige, and linguistic fluency, follows less from their capacity to capture epistemic quality than from their compatibility with computational optimization. In other words, what is most easily formalized becomes what is most readily valued. As D'Ignazio and Klein (2020) argue, data systems embed particular worldviews while presenting themselves as neutral and universal, since decisions about what is counted, how it is categorized, and what remains invisible are incorporated into technical architectures. Consequently, the organization of knowledge is not simply mediated by AI systems, but actively structured through the categories and metrics they operationalize.

A first domain in which these infrastructural effects become empirically observable is literature discovery. Here, AI-assisted review tools do not merely accelerate existing practices; rather, they reorganize them by redefining how relevance is identified, how topics are clustered, and, crucially, which sources become visible at all. Because recommender systems are typically trained on citation networks, they tend to privilege already highly cited publications, thereby reinforcing cumulative advantage dynamics (Beel et al., 2016). The resulting effect is a form of epistemic pre-filtering that shapes the field of possible knowledge in advance of any explicit evaluative judgment.

At this point, however, an important qualification is required. Research on network homophily shows that even in the absence of algorithmic intervention, structurally unbalanced networks tend to concentrate visibility around majority-group members. Karimi et al. (2018), for instance, demonstrate that when minority groups are underrepresented, even individually unbiased linking behaviour can produce systematically unequal outcomes. Applied to citation networks, this implies that AI systems inherit not only explicit biases but also the structural effects of homophily embedded

in the data. For this reason, it becomes analytically necessary to distinguish between concentration that would emerge from network structure alone and concentration that is further amplified through recursive AI-mediated feedback. Epistemic algorithmic drift designates precisely this latter process: the additional redistribution of visibility produced through the iterative interaction between system outputs and scholarly practices.

These dynamics resonate with a broader body of research indicating that automated classification and recommendation systems tend to reproduce existing social hierarchies under the guise of efficiency and objectivity (Benjamin, 2019; Crawford, 2021; Noble, 2018). At the same time, longstanding debates in science and technology studies caution against treating technological effects as inevitable or detached from institutional contestation and user agency (Pinch & Bijker, 1984; Winner, 1980). In this perspective, epistemic algorithmic drift is not conceived as an inevitable outcome, but as a structural tendency whose effects depend on how systems are designed, implemented, and governed.

Importantly, these mechanisms are not confined to literature discovery but extend to editorial infrastructures more broadly. Systems for reviewer identification and manuscript routing, for example, are increasingly built on historical publication records, reviewer activity, and editorial assignment data (Beel et al., 2016; Elsevier, 2024; Zhao & Zhang, 2022). Because these data are generated within academic environments long documented as structurally unequal, their use raises concerns about the reproduction of existing disparities within AI-assisted editorial decision-making. In parallel, the growing use of AI-assisted writing introduces unresolved questions concerning authorship and provenance, while the increasing entanglement of human and machine judgment complicates the evaluative boundaries of peer review (Hosseini & Horbach, 2023).

The extent to which these infrastructural effects can be empirically observed, however, varies across disciplinary contexts. In fields such as biomedical research, computer science, and physics, AI-assisted tools are already embedded in the operational workflows of major publishers and preprint platforms, making their distributional consequences, at least in principle, traceable. By contrast, in the social sciences and humanities, AI integration into editorial processes remains more uneven and less systematically documented, while bibliometric data disaggregated by gender and institutional position are less consistently available. As a result, disciplinary unevenness shapes not only the exposure to epistemic algorithmic drift but also the feasibility of monitoring it: fields in which AI integration is most advanced are simultaneously those most exposed to drift and those best positioned to generate the data needed to detect it.

Overall, these developments point to a structural transformation rather than a set of isolated distortions. Epistemic gatekeeping is progressively delegated to systems that operate outside the normative frameworks through which scientific communities have traditionally regulated evaluation and recognition. To be sure, algorithmic mediation can also introduce corrective effects, for instance, automated double-blind review may reduce reputational

bias, while AI-assisted translation can expand access across linguistic boundaries. Yet, in the absence of explicit design choices and accountability mechanisms, these benefits remain unevenly distributed. Ultimately, the same systems that can mitigate inequality under certain conditions can also intensify it under others, depending on how they are embedded, governed, and evaluated.

Unequal Conditions of AI Integration

The mechanisms of epistemic filtering described above do not affect all researchers in the same way. Their effects depend on who can engage with these systems and under what conditions. AI integration into academic work therefore unfolds within pre-existing structures of inequality that shape both access to these tools and their consequences for epistemic participation, at the intersection of gender, career stage, institutional position, language, and geography (Collins, 1990; Crenshaw, 1989, 1991).

A first axis of differentiation concerns the organization of academic labour. Time, as a key resource for research, is unevenly distributed: women researchers tend to carry disproportionate teaching, administrative, and mentoring responsibilities, which fragment the sustained time required for both intellectual work and experimentation with new technologies (Guarino & Borden, 2017; Schiebinger, 1999). The capacity to integrate AI into research practices thus depends on the availability of time, stability, and institutional support; in this sense, the relationship between gender and technology is mediated by the organization of labour (Wajcman, 2004).

Empirical evidence shows that engagement with AI tools varies systematically within this structured landscape. Dorta-González et al. (2024), in a large-scale cross-disciplinary and cross-national study, find that women researchers report higher levels of concern regarding the reliability, transparency, and ethical implications of generative AI, alongside more cautious patterns of use. This orientation can be understood as shaped by structural position: researchers whose work is subject to heightened scrutiny face stronger incentives to avoid practices whose legitimacy is not yet stabilized, consistent with evidence on gendered evaluation asymmetries in science (Wennerås & Wold, 1997). Over time, such caution may affect familiarity with emerging research practices and competitiveness in contexts where AI tools are increasingly integrated (Lund et al., 2024; Nicholas et al., 2024).

These dynamics are particularly pronounced among early-career researchers, for whom AI represents both an opportunity and a source of uncertainty. Nicholas et al. (2024) show that junior scholars use AI to accelerate aspects of research production while expressing concerns about authorship, originality, and evaluative legitimacy. When career precarity intersects with gender, these tensions may become more pronounced, limiting the capacity to absorb the risks associated with AI adoption.

Global and linguistic asymmetries further compound these dynamics. Women remain underrepresented in the global research workforce, with

significant regional disparities (UNESCO Institute for Statistics, 2024), while the large language models that underpin most AI tools are predominantly trained on English-language data, contributing to the centrality of standardized academic English in scholarly communication (Raitskaya & Tikhonova, 2025). Researchers working in other languages must navigate tools optimized for different linguistic environments while competing in systems that privilege linguistic conformity as a proxy for quality.

These dynamics interact with disciplinary structures in ways that compound rather than simply add their effects. In fields with strong international standardization — such as experimental biology or quantitative economics — the pressure toward linguistic and methodological conformity is already institutionally embedded, making AI-assisted standardization an accelerant of pre-existing tendencies. In fields characterized by greater methodological pluralism and stronger traditions of non-English scholarly production — including sociology, history, and area studies — the same tools may function as instruments of disciplinary boundary-drawing, privileging outputs that conform to dominant Anglophone conventions while rendering heterodox or regionally specific contributions less visible. The mechanism of drift is the same across these contexts; its rate and its consequences for epistemic diversity are not.

Considered jointly, these dimensions point to a differentiated landscape of AI integration in which constraints interact rather than simply accumulate. While the empirical literature has not yet fully captured these configurations, each of their constituent dynamics is well documented, and their interaction helps explain how these processes remain closely aligned with the inequalities that structure academic work more broadly.

Epistemic Algorithmic Drift: Concept, Mechanism, and Indicators

Against this background, the concept of *epistemic algorithmic drift* can be specified as a recursive process through which AI-mediated scholarly interactions progressively reorganize the distribution of visibility, recognition, and epistemic authority. Rather than referring to a single distortion or identifiable bias, the concept captures a dynamic: the gradual reorganization of epistemic opportunity that unfolds as AI-mediated outputs are integrated into scholarly practices and recursively incorporated into the infrastructures that shape subsequent outputs.

At its core, this process can be understood as a self-reinforcing feedback loop operating across four stages. First, AI systems are trained on scholarly data — citation networks, publication records, reviewer activity — that encode historically uneven distributions of recognition, including well-documented gender disparities (Larivière et al., 2013; Wennerås & Wold, 1997). Second, these systems operationalize such distributions through proxies of relevance, visibility, and expertise: highly cited work is more likely to be recommended, established publication patterns function as benchmarks, familiar reviewer profiles are more likely to be selected (Beel et al., 2016; Kousha & Thelwall,

2024). Third, researchers interact with these outputs, generating new data traces. Fourth, as these traces are incorporated into subsequent system updates, later outputs tend to reinforce earlier patterns. Over successive iterations, relatively small asymmetries can become more pronounced, leading to increasing concentration of visibility and recognition. No single decision need be overtly discriminatory for this to occur; the effect emerges from the recursive interaction between system outputs and scholarly practices.

It is this cumulative and recursive character of the process that makes it necessary to distinguish epistemic algorithmic drift from algorithmic bias. Algorithmic bias refers to systematic disparities in the outputs or decisions of algorithmic systems arising from the interaction of data, model design, target definitions, and deployment conditions (Barocas & Selbst, 2016; Suresh & Guttag, 2021). In this sense, it concerns the distributional properties of outputs at a given point in time. Epistemic algorithmic drift, by contrast, captures the temporal dynamics through which those outputs, once taken up in practice, contribute to reorganizing the distribution of epistemic opportunity over time. Bias may contribute to drift, but drift is not reducible to it.

Nor does the concept coincide with *concept drift* in machine learning, which refers to situations in which the underlying data-generating distribution shifts so that a model trained under earlier conditions becomes less reliable when applied to later data (Gama et al., 2014). There, the problem is primarily statistical: the environment changes and the model must be adapted. Epistemic algorithmic drift addresses a different phenomenon: not that the model loses accuracy, but that its repeated use progressively reorganizes the social distribution of visibility, recognition, and opportunity.

The concept also differs from familiar representations of inequality. The metaphor of *the glass ceiling* presupposes a discrete barrier that can be located and removed. Drift operates instead through incremental adjustments in probability that, over time, narrow trajectories without any single point of exclusion. A closer parallel can be found in *path dependency* (Mahoney, 2000; Pierson, 2000), which explains how past decisions constrain future possibilities through self-reinforcing mechanisms. Yet while path dependency captures institutional persistence, epistemic algorithmic drift describes an ongoing redistribution of opportunity generated through the continuous operation of AI systems on historically stratified data. Addressing path dependency involves reforming institutional arrangements; addressing drift requires intervening in the feedback dynamics through which inequalities are continually reproduced.

What distinguishes epistemic algorithmic drift from adjacent frameworks is its focus on a process that links infrastructural design, user interaction, and cumulative epistemic outcomes. Research on algorithmic discrimination (Barocas & Selbst, 2016) identifies conditions under which protected attributes affect outputs but remains oriented toward model-level properties. Work on feedback loops (Crawford, 2021) highlights self-reinforcing dynamics yet does not specify their epistemic consequences. Infrastructure studies (Bowker & Star, 1999; Star, 1999) explain how such processes become naturalized but do

not provide a mechanism for tracing their accumulation over time. Epistemic algorithmic drift brings these perspectives together by specifying how these dynamics converge within AI-mediated scholarly communication.

The phenomenon can be examined through patterned distributions over time, provided that data are available at sufficient granularity and over extended periods. Four indicators are proposed, each specifying an empirical referent, a data requirement, and a minimum analytical design. Their value lies not in isolation but in triangulation, and in each case the challenge of distinguishing drift from other sources of concentration must be confronted directly.

The most directly traceable indicator is citation concentration: a longitudinal increase in the share of AI-recommended or AI-retrieved literature attributed to already highly cited authors, controlling for publication output (Larivière et al., 2013). Operationally, this requires linking bibliometric data from Scopus or Web of Science to recommendation system logs across a pre- and post-deployment window of at least five years within specific disciplinary fields.

A complementary indicator is demographic narrowing in editorial roles: reduced gender and geographic diversity in AI-assisted reviewer selection relative to the pool of qualified scholars available in a given field (Helmer et al., 2017). This requires longitudinal access to journal manuscript systems and reviewer databases disaggregated by gender and institutional affiliation, tracked across editorial rounds over at least three years, and considering policy shifts independent of AI adoption.

Another indicator is linguistic standardization, understood as the convergence of AI-assisted manuscripts toward dominant forms of standardized academic English. This can be measured through stylometric analyses of corpora of submitted and published manuscripts, comparing periods before and after the documented adoption of automated writing tools. The main analytical challenge lies in distinguishing convergence driven by drift from patterns of author self-selection or from shifts in journal language policies that may have tightened independently, in line with broader evidence on linguistic inequalities in scholarly publishing (Raitskaya & Tikhonova, 2025).

Finally, agenda narrowing, considered as declining methodological and theoretical diversity among highly visible publications, can be operationalized through topic modelling of titles, abstracts, and keywords across bibliometric archives spanning at least ten years, segmented by citation quartile. The primary confound is genuine paradigm consolidation within a field, which requires qualitative disciplinary judgment to distinguish from algorithmically amplified concentration (Fortunato et al., 2018).

None of these indicators is conclusive in isolation. Their evidential value depends on triangulation across dimensions, on intersectional disaggregation of results by gender, geography, and career stage, and on the availability of data linking AI system deployment to observed distributional shifts. Considering that such data remain largely unavailable at present, these indicators are offered not as a measurement protocol ready for

implementation but as a specification of what an empirical research programme addressing epistemic algorithmic drift would need to produce.

The intersectional dimension of drift is not an additional layer but a defining feature of the process. The feedback dynamics described above do not operate uniformly: their effects vary across configurations of structural position. As Crenshaw (1989) has shown, approaches that consider inequality along a single axis risk overlooking compounded forms of marginalization; similarly, auditing AI systems for gender or geographic bias separately may fail to capture how these dimensions interact in practice. A further dimension concerns disciplinary position: exposure to drift is highest where AI integration into editorial and discovery infrastructures is most advanced, where bibliometric proxies carry the greatest institutional weight, and where the gap between dominant and marginal methodological traditions is widest. Future empirical work will therefore need to be disciplinarily situated rather than cross-field in its initial design.

The implications extend beyond distributive concerns to the epistemic quality of science itself. A research system that progressively privileges already dominant perspectives (whether methodological, linguistic, or theoretical) risks narrowing the range of questions that can be asked and the forms of knowledge that can be recognized as valid. This does more than reproduce inequality: it reduces the system's capacity for reflexivity, critique, and innovation. Epistemic algorithmic drift is therefore not only a matter of fairness, but of the long-term robustness of knowledge production.

Discussion: Implications for Governance

The analysis developed in this paper shifts the focus of governance from isolated errors or access gaps to the cumulative effects of AI-mediated systems. If the problem were limited to measurable disparities in a model's outputs, technical correction might constitute part of the response. If it were limited to unequal access to technology, redistributive measures might be sufficient. Epistemic algorithmic drift exceeds both diagnoses. It is a process through which the routine operation of technically sound and widely accessible AI systems, under conditions of pre-existing inequality, produces progressive redistributions of epistemic opportunity that are cumulative, intersectional, and largely invisible to the actors they most affect. Governance responses adequate to this diagnosis must be structural, longitudinal, and intersectional in design. Three levels of response can be distinguished, each corresponding to a different locus of intervention: institutional governance, system design, and scholarly practice.

At the level of institutional governance, this diagnosis implies requirements that go beyond the transparency commitments that publishers and funders typically invoke. Binns (2018) argues that fairness in machine learning is not a purely technical problem but a political one, requiring the prior specification of normative criteria before any technical implementation can proceed. Barocas, Hardt, and Narayanan (2023) demonstrate that different formalisations of fairness are mathematically incompatible: a system

optimized for individual fairness cannot simultaneously satisfy group fairness criteria, and the choice among them cannot be delegated to the algorithm. These insights translate into concrete governance requirements: algorithmic impact assessments must specify in advance which conception of fairness a tool is designed to realize; monitoring of citation and recommendation data must be intersectional rather than single-axis; reporting on reviewer pools must be disaggregated along multiple axes simultaneously; and investment in language-assistance training corpora must be accompanied by explicit commitments to linguistic diversity, rather than treating the dominance of English as a neutral technical baseline (Oermann et al., 2025).

At the level of system design, a growing body of research on fairness-aware recommender systems demonstrates that equity-oriented objectives can be incorporated into recommendation algorithms without prohibitive costs to performance (Burke, 2017). These contributions show that the choice of optimization target is a normative decision with measurable distributional consequences: systems optimized exclusively for citation-based relevance will systematically disadvantage minority-group scholars in homophilic networks, while multisided fairness criteria can partially counteract this effect. Translating these findings into scholarly communication infrastructures requires that publishers and platform providers specify in advance which conception of fairness their systems are designed to realize.

Another level of response concerns scholarly practice, though its limits must be acknowledged from the outset. The concept of epistemic algorithmic drift motivates what might be called *infrastructural reflexivity*: a systematic attentiveness, on the part of researchers and research communities, to the AI-mediated systems through which their work is shaped, circulated, and evaluated. The term is used here as distinct from the broader notion of reflexivity in social science methodology: it refers not to awareness of one's own positionality, but to critical engagement with the technical and institutional arrangements that mediate epistemic outcomes — arrangements that, as Star (1999) observed, typically recede from view precisely when they function most effectively. Zhu, Wang, and Sears (2025) propose pedagogical frameworks for critical engagement with generative AI in academic writing that address how AI participation in knowledge production should be understood and communicated. Such frameworks are necessary but insufficient: infrastructural reflexivity at the individual level cannot compensate for drift that operates at the system level. Thus, individual reflexivity is a condition of awareness, not a mechanism of structural change.

A risk cuts across the previous levels: the assumption that identifying bias is equivalent to addressing it, as illustrated by the “audit-as-endpoint” problem. (Metcalf et al., 2021). Sandvig et al. (2014) distinguish between process audits and outcome audits, arguing that neither is sufficient without institutional mechanisms capable of acting on findings. Raji et al. (2020) propose end-to-end internal auditing frameworks that integrate impact assessment into system development cycles rather than treating it as an external check applied after deployment. Applied to AI-mediated scholarly infrastructures, this implies that auditing epistemic algorithmic drift requires not only

longitudinal measurement of its indicators but institutional arrangements within which publishers, funders, and research communities can deliberate on findings and mandate corrective intervention. Without such arrangements, monitoring merely documents the progression of drift. Effective governance therefore requires intervention in the conditions that produce it, specifically, in the design of training data, the weighting of recommendation criteria, and the accountability structures that determine who benefits when AI-mediated systems perform well and who bears the costs when they do not. By their nature, these interventions are political as well as technical, requiring forms of collective deliberation that current AI governance frameworks in scholarly communication have not yet systematically enabled.

Conclusions

Proposed as a theoretical construct requiring empirical validation, epistemic algorithmic drift accounts for the cumulative, feedback-driven redistribution of epistemic visibility and authority produced by AI-mediated scholarly infrastructures under conditions of pre-existing inequality.

Three principal conclusions follow. First, epistemic algorithmic drift is a structural feature of AI-mediated scholarly infrastructures, not a correctable error. The Matthew and Matilda effects are not displaced by algorithmic systems; they are encoded in training data, reproduced in recommendations, and reinforced through the data trails that AI-mediated interactions generate. What changes is the mode of operation: from socially recognizable processes of recognition and attribution, visible and therefore contestable, to infrastructurally embedded feedback mechanisms, diffuse and therefore resistant to identification and challenge. Addressing drift requires intervening in the feedback loop, not merely auditing its outputs.

Second, the effects of epistemic algorithmic drift are irreducibly intersectional. Gender, geography, language, career stage, and institutional position do not produce independent and additive risks; they constitute configurations of structural location whose combined effects are qualitatively distinct from the sum of their parts. An adequate empirical account of drift therefore requires intersectionally disaggregated data, that capture not which categories are marginalized but which configurations of position are most exposed to the compounding dynamics described here. The current absence of such data makes drift structurally less legible and therefore less contestable. Generating such data is a prerequisite for effective governance.

Third, the governance responses adequate to epistemic algorithmic drift are structural, normative, and deliberative. They require the prior specification of which conception of epistemic fairness AI-mediated systems should realize; longitudinal and intersectional monitoring frameworks capable of detecting drift before it consolidates into entrenched advantage; and forms of collective deliberation among the communities most affected. The feminist epistemological tradition, and the intersectionality framework in particular, offer not only a diagnostic lens but a normative horizon: the goal is not merely

the correction of bias, but the construction of epistemic infrastructures that actively support plurality, reflexivity, and the equitable distribution of the conditions under which knowledge can be produced and recognized. Developing auditing frameworks, diversity-aware training protocols, and deliberative governance structures constitutes a concrete agenda for future research. Operationalizing this agenda will require longitudinal and intersectionally disaggregated studies capable of testing the indicators specified above across concrete AI-mediated scholarly infrastructures. Without this evidence base, the construct remains analytically productive but empirically unconfirmed, a condition this paper acknowledges and treats not as a deficiency but as the starting point for a research programme.

The question is not whether artificial intelligence will shape the epistemic future of science. The question that matters, analytically and politically, is whether the infrastructural conditions under which AI operates will be deliberately designed to distribute epistemic visibility more equitably than the hierarchies it currently inherits. The intersectional governance frameworks outlined here do not resolve that question; they attempt to specify, with sufficient analytical precision, what resolving it would require.

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Tools of Artificial Intelligence

AI tools were used exclusively for linguistic revision, stylistic refinement, and structural editing of the manuscript. The tools employed were general-purpose large language model assistants applied solely at the level of prose editing.

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The Meaning of the Untold: Intersectional Stories for Making Women in Science Visible

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Abstract: This paper examines the mediated representation of women in science within contemporary science communication environments, focusing on how visibility is constructed, constrained, and circulated across media infrastructures. Building on existing literature on gender and science, it identifies persistent patterns of underrepresentation and stereotypical framing in both media and public narratives. The study develops a ten-axis framework that synthesizes prior research on intersectional inequality in scientific contexts into an analytical tool for examining the multidimensional nature of scientific identities. It further discusses a set of illustrative examples that explore different configurations of scientific visibility across communicative contexts. The article argues that visibility is not a matter of simple inclusion, but a structurally mediated process shaped by narrative practices, institutional logics, and platform infrastructures that determine which scientific identities become recognizable, legitimate, and socially intelligible.

Keywords: Post-digital media environments; women scientists; intersectional representation; scientific visibility; platform infrastructures.

Introduction

Research on the media representation of women in science consistently identifies a persistent and structural issue: their invisibility. This invisibility operates on at least two interconnected levels. On the one hand, it is a matter of quantity. Women scientists appear less frequently in media narratives, whether in fictional contexts such as film and television or in non-fictional formats such as news coverage (Chambers, 2022; Steinke, 2017). As Eizmendi-Iraola and Peña-Fernández (2022, p. 12) observe, science continues to be portrayed as “a male environment in which women represent the exception.” Consequently, the limited presence of women contributes directly to their marginalization within the public imagination of science.

On the other hand, invisibility is also a matter of representation quality. Even when women scientists are present, they are often framed through restrictive and repetitive stereotypes that reduce the complexity of their identities. Early work by Steinke (1999, 2005) and subsequent analyses by Flicker (2008) identified recurring archetypes in the portrayal of female scientists, including the “old maid,” the “male woman,” the “naïve expert,” or the “lonely heroine,” among others. These categories have been revisited and confirmed in more

recent studies (Kool et al., 2022; Mejón & Jiménez, 2022), suggesting a strong continuity over time. Unlike broader typologies of scientists that focus on ethical roles or narrative functions irrespective of gender (LaFollette, 1990; Weingart et al., 2003), representations of women scientists have required distinct classifications, indicating that gender itself becomes a defining and constraining element. As a result, female scientists are not only underrepresented but also symbolically constrained, their visibility shaped by narrow and often stereotypical models.

This phenomenon extends beyond fictional media into journalistic coverage. News representations, while increasingly including references to women in science, tend to reinforce gendered expectations by associating women with specific fields, particularly those linked to care, such as health sciences (Eizmendi-Iraola & Peña-Fernández, 2022). Moreover, the presence of women is frequently framed as exceptional rather than ordinary, reinforcing the perception that STEM careers remain atypical for women. In this context, visibility becomes paradoxical: women may appear, but in ways that reaffirm their marginality rather than normalize their presence.

Understanding these dynamics requires situating them within the broader communicative conditions of post-digital society, in which the boundaries between digital and analog media have become increasingly blurred (Cascone, 2000; Gratani et al., 2023). In this environment, storytelling plays a central role in shaping cultural meaning, as narratives circulate across platforms through transmedia strategies and hybrid formats (Meyerhofer-Parra et al., 2024). One of the defining features of this context is cultural recycling, a process through which existing narratives are continuously reused, adapted, and amplified (Llamas Ubieta & Vollmeyer, 2024). As a result, what is already visible tends to be reproduced and multiplied, while what remains absent struggles to enter the cultural repertoire.

This recursive logic of visibility resembles a post-digital adaptation of Noelle-Neumann's (1974) spiral of silence. While the original theory focused on the social marginalization of minority opinions through self-censorship, contemporary platform environments generate comparable dynamics through algorithmic amplification, whereby already visible narratives gain further prominence and alternative representations remain difficult to discover (Duffy & Meisner, 2023). Consequently, invisibility is not only socially constructed but also technologically reinforced, as algorithmic processes privilege familiar and easily recognizable narratives. In the case of women in science, this dynamic contributes to the repeated circulation of stereotypical portrayals while limiting the emergence of alternative representations (Phillips et al., 2022).

Against this background, scholars have emphasized that more accurate and inclusive portrayals of women in science are both necessary and urgent. A growing body of work argues that media representations should move beyond stereotypical and exceptional narratives toward more diverse and realistic depictions (Kool et al., 2022; Chambers, 2022). As Chambers (2022, p. 483) argues, adopting an intersectional approach to representation can help redefine not only who scientists are but also what science itself is understood

to be. Such an approach requires recognizing that gender does not operate in isolation but intersects with other dimensions of identity, including race, class, age, and institutional position (Crenshaw, 1989, 1991; Collins, 2015).

However, despite the increasing acknowledgment of intersectionality as a key analytical framework, its application to the representation of women in science remains limited. Both media narratives and academic research have only partially addressed the complexity of intersectional identities, often privileging a narrow and normative profile of the female scientist. As Chambers and Thompson (2020) suggest, moving toward more equitable representation involves shifting from exceptional figures to the everyday realities of scientific practice, portraying women not as anomalies but as integral members of the scientific community.

In this context, the research has three main objectives: (1) to provide a state-of-the-art review of the representation of women in science, with particular attention to intersectional visibility; (2) to identify key axes through which intersectional inequality is structured in scientific contexts; and (3) to explore illustrative examples of narratives that seek to make these dimensions visible. By doing so, the paper argues that the visibility of women in science is not simply a question of representation, but a structurally mediated process shaped by post-digital narrative infrastructures that selectively enable, constrain, and circulate intersectional identities.

This article adopts a conceptual and interpretive approach rather than presenting original empirical data. Its contribution lies in synthesizing existing scholarship, proposing an analytical framework, and exploring illustrative cases that together enable a critical examination of how intersectionality is mediated within contemporary science communication. The aim is not to provide exhaustive empirical validation, but to develop a set of analytical tools and perspectives that can inform future research and practice.

Intersectionality and Women in Science: Theoretical Foundations and Research Trends

The concept of intersectionality has become a central analytical framework for understanding inequalities in contemporary societies. First introduced by Kimberlé Crenshaw (1989, 1991), intersectionality refers to the ways in which different axes of identity—such as gender, race, class, or age—intersect to produce specific and often compounded forms of disadvantage. Rather than conceptualizing social categories as independent variables, intersectionality emphasizes the mutually constitutive nature of power structures, highlighting how systems of oppression operate simultaneously and relationally. Building on Crenshaw's foundational work, scholars such as Patricia Hill Collins (2000, 2015) further developed the concept by introducing the idea of a “matrix of domination,” in which multiple forms of inequality are structurally embedded within institutions and cultural practices. In this paper, intersectionality is approached not only as an analytical framework for understanding inequality, but also as a representational problem that shapes

what kinds of scientific identities become visible and narratable in media contexts.

Although initially rooted in legal and Black feminist thought, intersectionality gained increasing prominence across disciplines from the late 1990s onwards, becoming particularly influential in sociology, gender studies, and media studies during the 2010s. Its expansion as a widely adopted analytical tool reflects a broader shift toward recognizing the complexity of social identities and the inadequacy of single-axis explanations of inequality (Keucheniuss & Mügge, 2021).

In the field of science and technology studies, however, the incorporation of intersectionality has been more gradual and uneven. Early work on gender and science focused primarily on quantitative disparities, such as the underrepresentation of women in STEM fields or the “leaky pipeline” phenomenon (Blickenstaff, 2005; Xie & Shauman, 2003). While these approaches were crucial in identifying structural inequalities, they often treated women as a homogeneous category, overlooking internal diversity.

The explicit application of intersectionality to women in science began to emerge more clearly in the last two decades. A foundational contribution is the work of Ong et al. (2011), which introduced the concept of the “double bind” to describe the intersecting disadvantages experienced by women of color in STEM. Similarly, McGee (2016) examined how Black and Latino college students in science navigate overlapping racial and scientific identities, revealing the emotional and structural tensions embedded in these trajectories. More recent studies have continued this line of inquiry by focusing on identity formation, belonging, and institutional barriers, often within educational contexts.

In the last five years, several authors have explicitly engaged with the concept of intersectionality when examining the representation of women scientists in the media. However, their thematic focus reveals a clear pattern: the intersectionality concept is predominantly mobilized to examine identity formation, structural inequality, and inclusion processes, rather than media representation as such.

A first notable feature is the strong emphasis on race and gender as intersecting axes, particularly in studies focusing on Black women in STEM. For example, Ibourk et al. (2022) explore how a young Black woman constructs her scientific identity through what they define as “storied identities,” showing how race, gender, and academic identity are interwoven across different life contexts. Their study highlights not only discrimination but also the emotional dimension of intersectionality, including self-doubt, resilience, and recognition, suggesting that belonging in science is shaped by both structural and affective factors. Similarly, Pietri et al. (2021) examine how different communication formats shape audiences’ identification with Black female scientists and their interest in STEM careers. Comparing video, audio, and written narratives featuring the same scientist, the authors found that video-based representations generated stronger perceptions of warmth, greater feelings of connection and identification, and, most importantly, higher levels of interest in computer science among Black female students than written

formats or control conditions. While this study engages more directly with questions of representation, its primary objective is to assess the relative effectiveness of communication formats in fostering STEM aspirations. As such, the analysis remains largely instrumental, focusing on the outcomes of narrative interventions rather than critically interrogating the narrative structures, meanings, or power dynamics through which these representations operate.

However, race is not the only axis addressed. Several studies broaden the scope of intersectionality by incorporating socioeconomic context, geographic location, and educational inequalities. Reznik et al. (2023), for instance, analyze the experiences of young women participating in STEM projects in low-income areas in Brazil. Their findings reveal how intersectionality operates across multiple dimensions, including class, race, family expectations, and local context. Particularly relevant is their identification of informal educational spaces as “counter-spaces,” where marginalized young women can challenge dominant norms, build self-confidence, and develop a sense of belonging in science.

In a similar vein, Mthembu et al. (2023) approach intersectionality through a public engagement initiative in African scientific contexts, highlighting how gender inequality intersects with cultural expectations, career stages, and caregiving responsibilities. Their analysis emphasizes structural constraints such as the perceived incompatibility between scientific careers and family roles, as well as broader institutional and societal barriers. Importantly, this study also foregrounds questions of power and representation, showing how communication strategies can be used to subvert dominant narratives and promote more inclusive forms of visibility.

Finally, Massarani et al. (2023) provide a perspective closer to media and cultural representation by analyzing audience responses to the film *Hidden Figures*, that portrays the trajectory of three black female NASA scientists, in the context of racial segregation in the USA in the 1960s. Their findings reveal a complex dynamic: while viewers celebrate the visibility of Black women scientists, they often interpret their success through individual meritocratic frameworks, thereby downplaying structural inequalities related to race and gender. The authors also identify the persistence of narrative tropes such as the “white savior,” demonstrating how even apparently progressive representations can reproduce dominant ideological patterns.

As mentioned above, in most of these studies, the emphasis tends to be placed on lived experience, education, and inclusion, rather than on the systematic analysis of media representations. Moreover, although race is a central dimension in several of these studies, intersectionality is also shown to involve other axes such as class, geography, caregiving responsibilities, and institutional position, pointing to the multidimensional nature of inequality in scientific contexts.

This reinforces the broader conclusion that, while intersectionality has gained visibility as a theoretical framework, its application remains uneven and domain-specific. In particular, its limited use in the analysis of media representations indicates a significant gap between the conceptual

development of intersectionality and its practical implementation in communication and cultural studies of science.

Expanding the Axes of Intersectionality in the Representation of Women in Science

Building on the gaps identified in the literature, this paper proposes a ten-axis intersectional visibility framework designed to systematize the multiple dimensions through which inequality is structured in scientific careers and, often unevenly, represented in science communication. These axes should not be understood as exhaustive or fixed categories, but as an analytical heuristic that makes visible the relational and context-dependent nature of intersectional inequality, while also highlighting the limits of its current representation in media narratives.

The framework is developed from and grounded in existing scholarship on intersectionality and its application to women in science, integrating theoretical contributions from gender studies, sociology of science, and science communication research in order to translate these analytical debates into a structured set of representational dimensions.

Race and ethnicity. Intersectional scholarship has repeatedly demonstrated that racialized women experience forms of exclusion that cannot be understood through gender alone. Women of color in STEM navigate multiple systems of inequality simultaneously, including racism, sexism, and institutional marginalization (Ong et al., 2011). These dynamics affect access to opportunities, mentoring relationships, professional networks, and recognition. As Collins (2015) argues, social identities operate through interconnected structures of power, making it essential to analyze race and gender as mutually constitutive rather than independent categories. Similarly, McGee (2016) highlights how racialized women in STEM frequently confront environments that question their belonging and legitimacy within scientific spaces.

Socioeconomic background. Access to scientific careers is shaped not only by individual talent but also by the availability of economic, social, and cultural resources. Bourdieu's (1986) concept of capital provides a useful framework for understanding how class-based advantages influence educational trajectories and professional opportunities. Research has shown that students from less privileged socioeconomic backgrounds often face additional barriers to entering and succeeding in scientific fields (Archer et al., 2015). As a result, the image of the scientist frequently reflects forms of social privilege that remain insufficiently acknowledged.

Migration and nationality. Scientific careers are often characterized by expectations of international mobility, yet opportunities for mobility are unevenly distributed. Migration status, citizenship, visa restrictions, and geopolitical inequalities can significantly shape access to scientific careers and professional advancement. Ackers (2004) demonstrates that mobility requirements may create particular challenges for women scientists,

especially when combined with family responsibilities and unequal access to international networks.

Institutional position. Hierarchical structures within universities and research organizations influence access to decision-making processes, leadership opportunities, and professional recognition. Acker (1990) argues that organizations themselves are gendered structures that reproduce inequalities through everyday practices and institutional norms. Building on this perspective, Van den Brink and Benschop (2012) show how recruitment and promotion processes frequently reproduce existing power relations, limiting women's access to senior academic positions and leadership roles. In addition, cross-national evidence on the "leaky pipeline" consistently indicates that women remain underrepresented in senior and executive positions within academia, suggesting that gender inequalities persist and often intensify at the highest levels of scientific governance (García Martín et al., 2024).

Employment precarity and career stage. Contemporary scientific careers are increasingly shaped by neoliberal transformations that have expanded temporary contracts, short-term appointments, and competitive funding structures, generating growing instability within academia. Although precarious working conditions affect many scholars, they often intersect with existing gender inequalities, placing women at greater risk of professional insecurity (Gill, 2009). As Mountz et al. (2015) argue, these transformations have intensified precarious academic labor and reinforced unequal distributions of vulnerability across already marginalized positions. Within this context, career stage functions as a key structuring dimension of inequality, referring to an individual's position within the scientific trajectory—from doctoral researchers and postdoctoral scholars to early-career academics and senior scientists. Access to resources, funding, mentoring, and professional visibility varies significantly across these stages, shaping opportunities for progression and consolidation. Understanding employment precarity and career stage as interconnected allows for a more nuanced account of how insecurity and stratification are reproduced throughout scientific careers rather than emerging at isolated points (García Martín et al., 2024).

Age. Age-related expectations and biases influence both participation in science and the recognition of scientific achievements. Research has shown that women frequently encounter age-specific stereotypes that affect perceptions of competence, authority, and commitment, particularly at critical points in their careers (Blickenstaff, 2005). Moreover, scientific trajectories are often shaped by age-related norms concerning productivity, family formation, and professional advancement, creating distinct challenges for women across different stages of life (Xie & Shauman, 2003).

Care responsibilities. The unequal distribution of domestic labor and caregiving responsibilities continues to shape women's participation in science. Numerous studies have documented how childcare, eldercare, and household work disproportionately affect women academics, influencing productivity, career progression, and work-life balance (O'Laughlin & Bischoff, 2005). These challenges are particularly significant in institutional cultures

that continue to reward uninterrupted career trajectories and long working hours. Mason et al. (2013) demonstrate that caregiving responsibilities remain a major factor influencing retention and advancement in academic careers, particularly for women.

Gendered bodily experiences. Scientific careers are often organized around assumptions of continuous productivity, mobility, and availability that overlook gendered bodily experiences. Physiological processes and health conditions that disproportionately or exclusively affect women—including menstruation, endometriosis, pregnancy, postpartum recovery, lactation, and menopause—may affect participation in research activities and career progression. Studies have documented how pregnancy and postpartum periods can create challenges for academic productivity and advancement (Mirick & Wladkowski, 2018; Russo, 2024), while lactation and field-based research may limit opportunities for mobility and participation in certain forms of scientific work (Hetherington et al., 2025). Other scholars have also highlighted the limited recognition of menstrual health and menopause within research institutions and gender equality policies, and posed recommendations to improve institutional support for women researchers in these areas (Cocco, 2024).

Disability. Scholars have increasingly highlighted the persistence of ableist structures within academia and scientific institutions. These barriers may involve inaccessible infrastructures, exclusionary organizational practices, or assumptions regarding productivity and competence (Brown & Leigh, 2018). For women with disabilities, gendered and ableist forms of discrimination frequently intersect, producing experiences that remain underrepresented in both research and public narratives about science.

Sexual orientation and gender identity. Scientific institutions have historically been shaped by heteronormative and binary understandings of gender, which can marginalize LGBTQ+ individuals and limit their visibility within scientific communities. Experiences of exclusion, discrimination, and lack of representation continue to affect lesbian, bisexual, transgender, non-binary, and gender-diverse scientists. As Armada-Moreira et al. (2021) argue, increasing the visibility of transgender, non-binary, and genderqueer scientists is essential for challenging normative assumptions about who can belong in science and for expanding the diversity of scientific identities represented in both academic and public spheres.

This framework thus provides a foundation for examining how storytelling practices selectively render certain dimensions of identity visible while leaving others untold within post-digital science communication.

Illustrative Narratives of Intersectional Visibility in Science Communication

As previous sections have shown, dominant representations of women in science often fail to capture the complexity of intersectional identities and inequalities. While intersectionality has become an increasingly influential

framework in science communication research, its practical incorporation into public narratives remains uneven. Instead of presenting a systematic sample or a set of case studies, this section offers several illustrative examples of storytelling practices that seek to make intersectional dimensions of scientific identities visible.

The examples have been selected to represent four distinct types of communicative agents and structures: (1) individual self-representation, where a scientist actively constructs a public identity through digital platforms; (2) curated digital storytelling, in which scientific identities are mediated through collective editorial selection and platform aesthetics; (3) hybrid academic–public engagement initiatives, in which institutional and public communication intersect through performative formats; and (4) research-based institutional intervention, operating at the level of media systems and communication practices.

These examples emerge within a post-digital communicative environment in which visibility is no longer determined solely by traditional media, but co-produced through the interaction of digital platforms, institutional actors, and narrative practices. In this context, storytelling becomes a key mechanism through which scientific identities are constructed, circulated, and negotiated across multiple communicative spaces.

(1) One increasingly visible form of intersectional storytelling is based on self-representation through social media. Rather than being portrayed by journalists, institutions, or fictional narratives, some scientists actively construct public identities that integrate their scientific work with personal experiences and social identities. Physicist and science communicator Clara Nellist (@particleclara) provides a notable example of this practice. Through Instagram and other digital platforms, Nellist combines science communication with reflections on gender, diversity, and LGBTQ+ inclusion in STEM. During Pride Month 2025, for example, she publicly stated: “This is a general reminder that I am a queer scientist and stand in support of all LGBTQ+ folks around the world.” Such statements do not merely communicate personal information; they integrate scientific and queer identities within a single public narrative. Through this autobiographical and testimonial form of storytelling, intersectionality becomes visible through self-disclosure and lived experience, challenging traditional representations of scientists as neutral, disembodied, and socially homogeneous figures.

(2) A second illustrative case is provided by *Women Doing Science*, a European storytelling initiative that curates narratives of women scientists through social media platforms, primarily Instagram (Women Doing Science, n.d.). Its stated aim is to “show the diversity of women in science and inspire future generations,” and it does so by broadening visibility across disciplines, geographical contexts, and professional trajectories. The project presents scientific identities through short biographical narratives that combine portrait photography and concise textual descriptions, producing an accessible and visually coherent archive of scientific lives. Intersectionality is addressed in an embedded rather than explicit manner, with dimensions such as race, nationality, institutional position, and career stage emerging

through individual stories rather than structured categories. From a post-digital perspective, the project operates through platform logics in which visibility is shaped by algorithmic circulation, repetition, and visual economies of recognition. Instagram is not simply a dissemination tool but a constitutive environment in which scientific identity is continuously produced and negotiated through sharing practices and aesthetic framing.

(3) A third example is *Soapbox Science*, founded in the United Kingdom by researchers at King's College London and the University of Bristol, which reimagines scientific communication by relocating it into public urban spaces (Soapbox Science, n.d.). Its mission is "to bring science to the public," enabling women and non-binary scientists to present their research in streets and public squares. The project engages primarily with gender and institutional position as its core axes of intersectionality, while also touching upon career stage and embodied dimensions of scientific labor. Its format is fundamentally performative: scientists communicate without institutional staging, relying instead on speech, presence, and direct interaction with audiences. In post-digital terms, *Soapbox Science* operates through a hybrid ecology in which embodied performance is extended through digital circulation, including photography, video, and social media dissemination. Scientific authority is therefore not pre-given but emerges through situated encounters in which knowledge is performed, observed, and collectively negotiated in real time.

(4) Finally, *WIM – Women Scientists in the Media* is a research and intervention project based at the University of Applied Sciences Potsdam in Germany, focused on the representation of women scientists in media ecosystems (WIM, n.d.). Its main objective is to address institutional position as a central axis of inequality, while also engaging with broader issues of gender visibility, career stage, and structural asymmetries in scientific communication. The project states that "visibility shapes authority," a principle that underpins its analytical and practical work on media representation. Rather than producing narratives of scientific identity, WIM examines the infrastructures that shape visibility, including journalistic practices, editorial selection processes, and algorithmically mediated forms of exposure. The project combines empirical analysis with practical recommendations for improving media representation, positioning itself at the intersection of research and intervention. In a post-digital context, it operates across interconnected environments that include journalism, institutional communication, and digital platforms. Visibility is therefore understood not as a static outcome but as a process shaped by multiple mediating layers that determine how scientific authority is constructed and circulated.

Across these examples, gender remains a transversal axis, while institutional position and career stage emerge as recurrent structuring dimensions. Race and nationality are more explicitly present in digitally curated storytelling formats such as *Women Doing Science*, whereas embodied dimensions of scientific practice are particularly visible in *Soapbox Science* through its emphasis on public performance, and queer identity is foregrounded in Clara Nellist's case as an explicit, self-articulated axis of intersectionality that cuts across professional and personal domains.

At the same time, these initiatives remain partially embedded in the very media logics they seek to challenge. Algorithmic visibility, aesthetic norms, and platform economies continue to structure the conditions under which intersectional identities can be articulated, recognized, and sustained in public discourse.

Discussion

This paper has advanced two main analytical contributions: a ten-axis framework for understanding intersectionality in the representation of women in science, and a set of illustrative examples that explore situated forms of scientific visibility across different communicative contexts. Rather than functioning as empirical findings, these contributions operate as interpretive tools to examine how intersectionality is negotiated within science communication and how storytelling mediates between scientific identities, media infrastructures, and public perception.

In dialogue with the literature, the ten-axis framework confirms that intersectionality, as theorized by Crenshaw (1989, 1991) and Collins (2015), depends on understanding identity categories as mutually constitutive rather than independent. The analysis shows that this relational logic is increasingly acknowledged in science communication research, but unevenly translated into representational practices (Chambers, 2022; Kool et al., 2022). Gender remains the most consistently visible axis across narratives, while other dimensions such as institutional position, career stage, race, and nationality appear selectively depending on the communicative context.

The literature on academic labor further helps situate these patterns. As Gill (2009) and Mountz et al. (2015) argue, neoliberal transformations in academia intensify precarity and reinforce structural inequalities. These dynamics are reflected in the salience of career stage and institutional position as structuring axes of visibility. Similarly, longstanding evidence on the “leaky pipeline” in STEM (Blickenstaff, 2005; Xie & Shauman, 2003) resonates with the uneven distribution of visibility across academic trajectories, reinforcing the link between representation and structural conditions of scientific careers.

The illustrative examples suggest that intersectional visibility is shaped not only by content but also by media form and institutional configuration. Platform-based curation, performative public engagement, and institutional media intervention each generate different regimes of visibility. These regimes determine which dimensions of identity become narratable, which remain implicit, and how scientific authority is constructed within specific media ecologies. Across these examples, storytelling emerges as a mediating infrastructure that organizes attention, shapes recognition, and structures affective engagement with science.

From this perspective, intersectional storytelling does not simply expand the range of visible identities, but redefines the epistemic boundaries of what counts as science and who can be recognized as a legitimate scientific subject.

Conclusions

The analysis presented in this article highlights the persistent gap between the growing visibility of women in science and the limited ways in which such visibility is constructed. Although research on gender and science communication has expanded considerably, intersectionality remains unevenly integrated into both analytical frameworks and representational practices. This is particularly evident in post-digital environments, where visibility is no longer solely a matter of inclusion, but is shaped through the interaction of narrative choices, institutional frameworks, and platform infrastructures. This suggests that future research should move beyond measuring representation to examining the infrastructural conditions that govern visibility, including platform design, algorithmic curation, and institutional communication practices.

In this regard, the ten-axis framework developed in this study helps to conceptualize inequality as a distributed and relational phenomenon. Rather than operating through a single dimension, intersectionality unfolds across multiple, interconnected axes—including gender, race, class, career stage, institutional position, and embodied experience. These axes do not function as fixed categories, but as shifting conditions that influence how scientific identities are made visible, and which aspects of those identities become narratable in public discourse.

The selected examples suggest that narrative practices play a central role in the production of scientific visibility. Although these examples are presented as illustrative rather than systematically analyzed, they indicate that storytelling does not simply expand representation, but organizes it. Across different communicative configurations—including digital curation, public engagement, and institutional mediation—distinct narrative formats appear to produce different regimes of legibility, shaping which scientists become recognizable and which dimensions of their identities are foregrounded or omitted. In this sense, visibility can be understood as a structured process rather than a neutral outcome.

This brings attention back to the broader implication of the study: that representation in science communication cannot be reduced to a question of presence or absence. It is shaped by the conditions under which identities become communicable and intelligible within specific media environments. What is at stake is therefore not only who is seen, but how visibility itself is produced, stabilized, and circulated. Developing more inclusive forms of science communication therefore requires not only diversifying representation, but also transforming the narrative and infrastructural conditions that determine how visibility is produced and legitimized.

Ultimately, this leads back to the central tension suggested by the title—The Meaning of the Untold: Intersectional Stories for Making Women in Science Visible. What remains untold is not merely missing from discourse; it is shaped by the conventions, infrastructures, and narrative expectations that govern what can be said, shared, and recognized as meaningful within contemporary science communication. What remains untold is thus not simply absent from

discourse, but structurally conditioned by the narrative, technological, and institutional boundaries that define what can be seen, known, and valued as science in post-digital society.

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Author Contribution

Isabel Palomo-Domínguez is the sole author of this paper and carried out all stages of the research, including conceptualization, theoretical development, analysis, and manuscript preparation.

Tools of Artificial Intelligence

Artificial intelligence tools were used exclusively for language correction, stylistic refinement, and structural editing of the manuscript. In particular, general-purpose large language model assistants, including ChatGPT and Microsoft 365 Copilot, were employed solely to enhance clarity and quality of the written expression, without contributing to the conceptual development, analysis, or substantive content of the study.

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The Research and Gender Committee of RAICEX (Spanish Network of Researchers Abroad): Advancing the Visibility of Women in Science

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Abstract: The RAICEX Research and Gender Commission (IgR) promotes the visibility and support of women in science through outreach, international cooperation, and gender-equality research, focusing especially on Spanish women researchers abroad. Its main objective is to reduce the gender gap and foster sustainable equality in science and technology. Using a qualitative case-study approach, the Commission gathers experiences from Spanish women scientists working in over 30 countries across five continents. Since 2019, it has organized videos, conferences, panel discussions, surveys, and thematic campaigns highlighting women's contributions to science. Key outcomes include the international roundtable Gender Equality Policies in Science: An International Perspective (2021), the 11F video campaign (2022), and the White Paper on Gender Policies in Science and Academia (2025). These initiatives address structural inequalities and career barriers through an intersectional and international perspective while strengthening global networks and promoting evidence-based policies for inclusive scientific environments.

Keywords: Gender equality; Women in Science; Intersectionality; Research policy; International collaboration.

Introduction

The Red de Asociaciones de Investigadores y Científicos Españoles en el Exterior (RAICEX) aims to foster the exchange of knowledge and experiences between Spanish researchers working abroad (see Fig. 1) and all stakeholders within the Spanish System of Science, Technology and Innovation. It serves as an advisory body, a channel for information, and a catalyst for international scientific collaboration, contributing to the advancement of science.

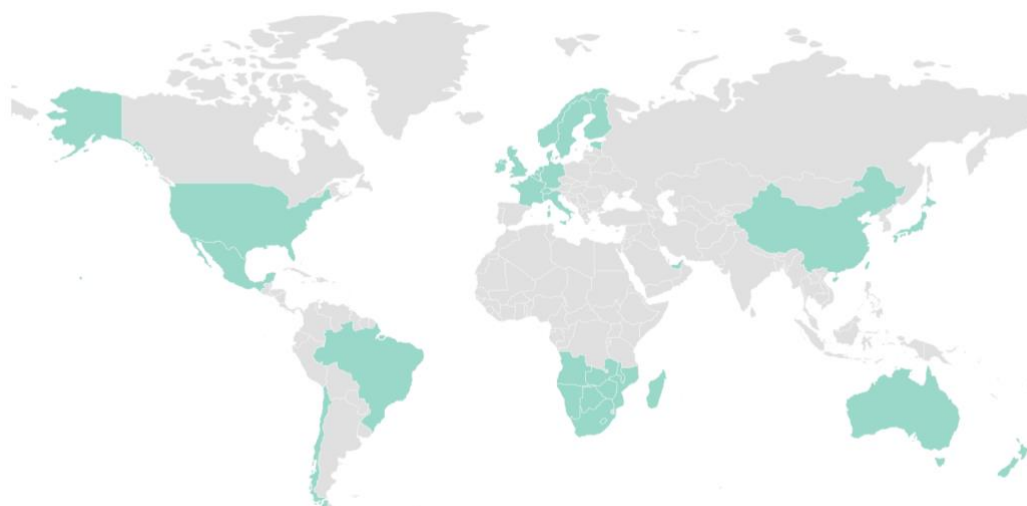


Fig. 1. Countries with an association member of RAICEX in 2026 (source: RAICEX website)

Since its foundation in 2018, RAICEX identified the need to establish a dedicated commission to promote the visibility and support of women in science and academia. This led to the creation of the Research and Gender Commission, hereinafter referred to as IgR. Its mission is to advance outreach, international cooperation, and research on the status of women scientists—particularly Spanish researchers abroad. Its primary goal is to reduce the gender gap and drive progress toward genuine equality in science and technology.

The IgR Commission was created in response to the persistent structural inequalities that continue to affect women and other underrepresented groups in science and academia worldwide. Despite the growing implementation of gender equality policies, important barriers remain embedded within academic and research systems, including unequal career progression, gendered care responsibilities, underrepresentation in leadership positions, and evaluation models that frequently reproduce structural bias. In many contexts, equality policies have prioritized formal compliance rather than transformative institutional change, revealing a significant gap between policy design and effective implementation.

Against this background, the Commission emerged as a collaborative and international initiative aimed at fostering reflection, visibility, and collective action around gender equality in science. Through outreach, research, international cooperation, and community-building activities, the Commission seeks to contribute to more inclusive, equitable, and sustainable scientific environments. Its work is grounded in the belief that gender equality is not only a matter of social justice, but also a necessary condition for strengthening scientific excellence, diversity, and innovation.

This paper aims, first, to describe the creation, structure, and mission of the IgR Commission as an international initiative within a scientific association. Second, it seeks to present and analyze the Commission's program of activities designed to build community, encourage critical reflection, and promote transformative actions regarding gender equality in science and academia. Finally, the paper examines the Commission's most ambitious initiative to date, the White Paper on Gender Policies in Science and Academia, highlighting its objectives, methodological approach, and principal findings concerning international gender equality policies and practices in research and higher education institutions.

The IgR Commission

The IgR Commission is composed of more than 20 members—predominantly women—who have been volunteering their time since 2019 to carry out activities throughout the year. These efforts place particular emphasis on key dates such as the International Day of Women and Girls in Science (11 February) and International Women's Day (8 March), while also recognizing the importance of promoting gender equality every day of the year.

The IgR Commission adopts a qualitative case-study approach, drawing on the experiences of Spanish women scientists working in research centers and universities across more than 30 countries on five continents. The Commission considers that understanding the root causes of inequality is a fundamental first step toward achieving effective gender equality in science.

Activities are organized both in-person and virtually, ensuring broad engagement and maximizing their impact across members of all affiliated associations. The Commission has organized panel discussions featuring leading experts on each topic and has scripted and produced videos aimed at raising public awareness about the gender gap and the importance of gender equity in science and academia. Surveys have been designed and administered, with the results analyzed to highlight issues such as gender-based violence in healthcare. Additionally, a variety of materials have been created to showcase the diversity of women scientists within RAICEX, illustrating their research across different countries and fields of knowledge. Members have also participated in academic and scientific diplomacy events to share the Commission's findings and lessons learned, helping to guide and shape initiatives in subsequent years.

Activities carried out by the IgR Commission

Since 2019, the Commission has developed a wide range of initiatives, including videos, international conferences, panel discussions, surveys, and

thematic calendars highlighting the role of women in science worldwide. Many of these actions were carried out in connection with key international dates such as 11F and 8M. These initiatives are described in greater detail below.

In 2021, the IgR Commission organized the international roundtable Gender Equality Policies in Science: An International Perspective (see Fig. 2). The event brought together a panel of Spanish scientists working in five different countries—Mexico, Japan, Sweden, the Netherlands, and the United Arab Emirates—who discussed how these national contexts have approached the implementation of gender equality policies in science. The discussion also explored the lessons that could be applied to the Spanish context, promoting international comparative reflection on effective strategies, institutional challenges, and best practices for advancing gender equality in research and academia (Fig. 2).



Fig. 2. Gender Equality Policies in Science: An International Perspective (source: [YouTube](#))

During 15–17 September 2021, the IgR Commission participated in the 11th European Conference on Gender Equality in Higher Education, held online and organized by the Spanish Ministry of Science and Innovation and the Spanish Ministry of Universities, in collaboration with Universidad Politécnica de Madrid as the hosting institution, with the support of the European Network on Gender Equality in Higher Education and other Spanish stakeholders. We presented the study entitled *Gender Equality Policies in Research and Innovation: A Comparative Analysis of Italy, Japan, Spain, Sweden, Switzerland, the United Kingdom and the Netherlands* (García-Martín et al., 2021), conducted by the IgR Commission. This comparative study

would later become the foundation for the development of the *White Paper on Gender Policies in Science and Academia*.

In 2022, on the occasion of the International Day of Women and Girls in Science (11 February), the Commission produced the video *Por la igualdad de género en la carrera investigadora* (see Fig. 3). The video explored how gender inequality affects women's scientific careers and examined the broader social consequences of these disparities, while also highlighting measures adopted by different countries to foster more equitable research environments.

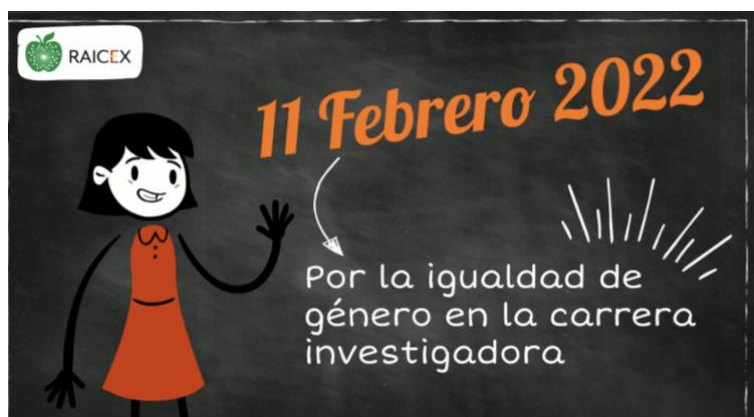


Fig. 3. Video “For gender equality in research careers” (source: [RAICEX YouTube channel](#))

That same year, Eva Ortega Paíno, Secretary General for Research at the Spanish Ministry of Science, Innovation and Universities, participated in a discussion together with Soledad Murillo, former Spanish Secretary of State for Equality and professor of Sociology at the University of Salamanca; Marta Macho, mathematician and science communicator at the University of the Basque Country; and Patricia Fernández de Lis, journalist and head of science and technology at El País. The discussion focused on the need to move beyond gender equality legislation toward greater social and professional visibility of these issues (see Fig. 4).



Fig. 4. Video “From gender equality laws to social and workplace visibility” (source: RAICEX YouTube channel)

In 2023, a calendar was produced with the participation of members from all RAICEX associations, who shared their research profiles together with personal reflections, concerns, and curiosities. The initiative served as a way to give visibility and voice to women scientists, highlighting both their professional trajectories and their perspectives on contemporary challenges in science and academia. The cover and the month of January can be seen in Fig. 5.



Fig. 5. RAICEX Women's Calendar. a) Front page; b) Example for the month of January

The year 2024 was one of the most productive periods for the IgR Commission, marked by a broad range of initiatives including videos, surveys, and webinars. To commemorate the International Day of Women and Girls in Science (11 February), the Commission released the video *11F 2024 – Comisión de*

Investigación y Género de RAICEX (IgR), featuring several scientists from the Commission who reflected on their motivations for participating in IgR and emphasized the importance of collective initiatives aimed at advancing gender equality in science. The video also highlighted the potential impact of these actions on present and future generations, particularly through awareness-raising campaigns linked to internationally significant dates.

For International Women's Day (8 March), the Commission conducted a survey exploring perceptions and experiences related to gender stereotypes, followed by the production of a visual report summarizing the principal findings. In May, coinciding with the International Day of Action for Women's Health, additional surveys addressing gender bias and discrimination in healthcare and research environments were launched (see Fig. 6). The results of these initiatives were subsequently disseminated on 25 November, the International Day for the Elimination of Violence against Women, reinforcing the Commission's commitment to raising awareness of structural inequalities and gender-based violence across scientific and academic contexts.



Fig. 6. Results of surveys on gender bias in medicine

Finally, on 3 October 2024, in collaboration with PRISMA, the Commission organized the webinar LGBTQIA+ Diversity in Science, Technology and Innovation (see Fig. 7). The event created a space for reflection on diversity, inclusion, and the challenges faced by LGBTQIA+ individuals within scientific and technological environments. In addition, the Commission coordinated a working group composed of experts as part of the IX Scientific Diplomacy Conference, held in Madrid, Spain, on 18 December 2024.



Fig. 7. Poster for the webinar “LGBTQIA+ Diversity in Science, Technology and Innovation”

On 14 February 2025, on the occasion of the 11F celebrations of this year, one of the most important works carried out by the IgR Commission, initiated in 2021, was presented: *The White Paper on Gender Policies in Science and Academia* (García-Martín et al., 2024) (see Fig. 8). The book provides a comparative analysis of gender policies in fourteen countries across Europe, the Americas, Asia, and Oceania. The aim of this study is to identify structural barriers, evaluate existing policy frameworks, and highlight effective practices that may contribute to more inclusive academic environments.



Fig. 8: Presentation of The White Paper on Gender Policies in Science and Academia: coordinators, authors and the president of RAICEX (14 February 2025, Madrid, Spain)

The White Paper on Gender Policies in Science and Academia

Building on the presentation of a communication at the XI European Conference on Gender Equality in Higher Education (2021) and the success of the comparative analysis of gender policies in science and academia across seven countries, the Commission launched its most ambitious project to date: the *White Paper on Gender Policies in Science and Academia* (García Martín et al., 2024). This initiative represents a strategic effort to consolidate knowledge, identify best practices, and propose actionable recommendations for advancing gender equality in scientific and academic careers globally.

It is based on a qualitative comparative analysis of gender equality policies in science and academia across fourteen countries included. The authors compiled information collected by researchers located in different national contexts.

The research follows a descriptive and comparative methodology. First, national reports were prepared for each country using publicly available sources, including government policies, equality legislation, institutional frameworks, and statistical data on gender representation in academia and research. These reports were then analyzed to identify common patterns, differences between countries, and key policy measures aimed at promoting gender equality in science.

The comparative analysis focused on several dimensions: the existence of gender equality legislation, institutional equality plans, initiatives promoting women in STEM disciplines, mechanisms for monitoring gender

representation, and policies supporting work–life balance. Special attention was given to structural barriers affecting women's career progression, such as promotion systems, leadership representation, and cultural norms within academic institutions. The comparative analysis includes fourteen countries across Europe, the Americas, Asia, and Oceania.

Next, we will summarize some of the most relevant findings of the book, given their importance. The analysis identifies common patterns across countries in gender representation and policy approaches in science. A persistent gender gap exists: although women are well represented among graduates and early-career researchers, their presence declines at senior levels. Figure 9 illustrates this generalized decline across the countries analyzed in women's representation as their careers progress, from postdoctoral (Grade D) to Full Professor (Grade A). On average, women make up 37.9% of researchers, but only 28% of full professors and about 10% of leadership roles.

Both horizontal and vertical segregation remain evident. Women are underrepresented in STEM fields and progressively less present at higher academic ranks. While many countries have implemented gender equality policies—such as mandatory equality plans, data collection, and work–life balance measures—these do not always lead to substantial improvements.

Policy approaches vary: some countries rely on legislation, while others use targeted programs. Examples include Sweden's gender mainstreaming, the Netherlands' Aspasia Program, and Australia's SAGE initiative. Despite these efforts, structural and cultural barriers—such as caregiving responsibilities, productivity-based evaluation systems, and implicit bias—continue to hinder women's advancement. Overall, policy effectiveness depends on addressing systemic barriers and ensuring institutional accountability.

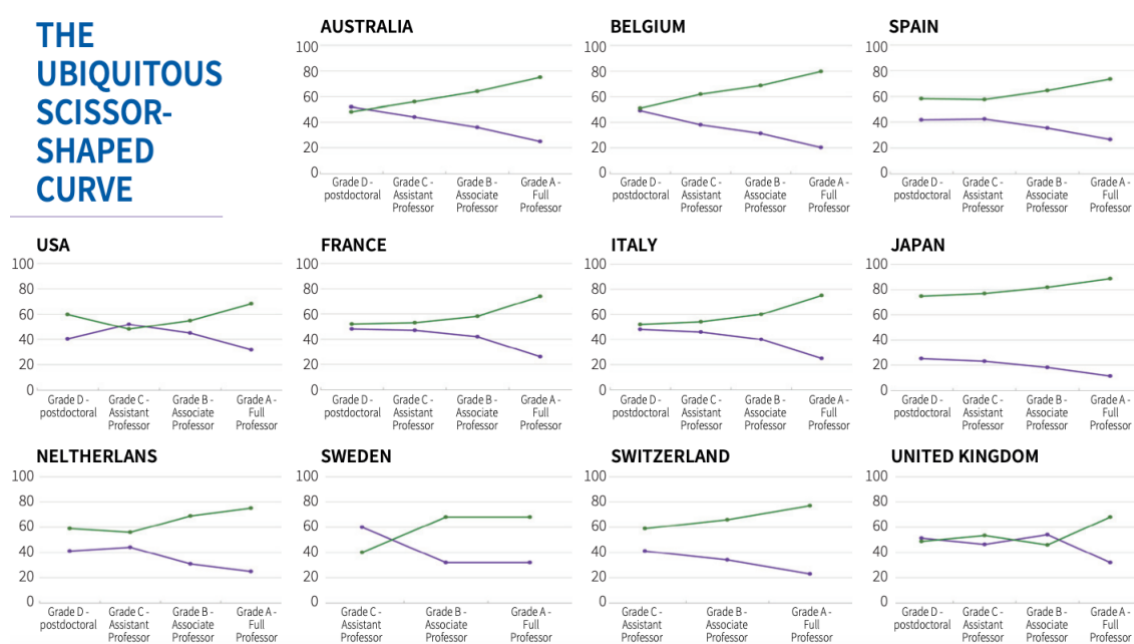


Fig. 9. The “Scissor-Shaped Curve” in Academic Careers: Gender Representation Across Countries (created by the authors based on García-Martín et al., 2024)

Figure 9 provides an overview of the main trends identified in the White Paper on Gender Policies in Science and Academia, illustrating gender representation across academic career stages in selected countries. The figure highlights the well-known “scissor-shaped curve,” in which the proportion of women progressively decreases at higher academic ranks. It was developed by the authors using national statistical data compiled and comparatively analyzed within the framework of the White Paper.

Discussion

The discussion of this study is primarily grounded in the key findings of the *White Paper on Gender Policies in Science and Academia*, which provide a robust comparative perspective on gender inequality across diverse national contexts.

While the study offers a comprehensive international overview, certain limitations must be acknowledged. The analysis relies largely on secondary data and national reports, whose availability, quality, and level of detail vary across countries. Moreover, important differences may exist within countries—particularly in decentralized or federal systems—where institutional practices are not uniform. Despite these constraints, the comparative approach remains valuable for identifying both shared structural challenges and transferable policy practices.

One of the most significant findings is that gender inequality in science and academia is a global and systemic phenomenon, largely independent of geographical, cultural, or economic context. Across all countries analyzed, similar patterns emerge: women are well represented in early academic stages but remain underrepresented in senior and leadership positions. This reinforces the idea that the issue is not simply one of access, but of progression and retention within academic systems.

A central insight of the analysis is the persistent gap between formal policy frameworks and their effective implementation. Although most countries have adopted gender equality legislation and institutional plans, these often function as compliance mechanisms rather than drivers of structural change. Monitoring systems are frequently weak, indicators are not always standardized, and accountability mechanisms remain insufficient. As a result, the transformative potential of these policies is limited.

The study also highlights the continued influence of structural and cultural barriers. Academic career models are still largely based on uninterrupted productivity and linear progression, which disproportionately disadvantage women, particularly due to caregiving responsibilities. These gendered career patterns contribute significantly to vertical segregation and help explain the “scissor-shaped curve” observed across countries. Furthermore, implicit biases

in recruitment, evaluation, and promotion processes continue to affect decision-making, often in subtle but cumulative ways.

Importantly, the comparative perspective allows the identification of more effective policy approaches. The results suggest that isolated or symbolic measures are insufficient. Instead, policies that combine several elements—such as institutional accountability, measurable targets, transparent evaluation criteria, and structural reforms—tend to produce more meaningful outcomes. Initiatives that integrate gender mainstreaming, targeted funding programs, and accreditation or certification systems appear particularly promising, as they incentivize institutional change rather than mere formal adherence.

Another relevant contribution of this work lies in its international and network-based perspective. By drawing on the experiences of researchers across multiple countries, the study highlights the importance of transnational knowledge exchange and scientific diaspora networks in advancing gender equality. Organizations such as RAICEX play a key role in this regard, acting as bridges between different systems and facilitating the transfer of successful practices and policy innovations.

Finally, the findings reinforce the need to move beyond descriptive analyses toward more action-oriented and evidence-based policy design. Future efforts should focus not only on identifying barriers, but also on systematically evaluating the impact of existing measures. Strengthening data collection, harmonizing indicators, and promoting longitudinal studies will be essential to better understand what works, under which conditions, and why.

In this context, the work of the IgR Commission contributes to a broader agenda that seeks to transform scientific systems into more inclusive, equitable, and sustainable environments. Addressing gender inequality in science is not only a matter of social justice, but also a strategic priority for enhancing the quality, diversity, and impact of research at a global scale.

Conclusions

Gender inequality in science and academia remains a persistent and global structural issue despite the widespread implementation of equality policies.

First, although many countries have developed legal frameworks and institutional gender equality plans, these measures often prioritize formal compliance over substantive structural change.

Second, systemic barriers—including gendered career patterns, caregiving responsibilities, and productivity-based evaluation systems—continue to hinder women's progression, particularly at senior and leadership levels.

Third, a significant gap persists between policy design and effective implementation, with limited monitoring, accountability, and measurable outcomes in many institutional contexts.

Effective advancement toward gender equality in science requires comprehensive and systemic approaches.

First, policies must integrate institutional accountability, transparent recruitment and promotion processes, and continuous monitoring of gender indicators.

Second, successful strategies are those that combine legislative frameworks with targeted programs and structural reforms addressing implicit bias and organizational culture.

Third, international comparative analyses, such as the White Paper on Gender Policies in Science and Academia, provide valuable evidence to identify best practices and support their transfer across contexts.

Promoting gender equality in science is essential not only for fairness but also for enhancing innovation, diversity, and excellence in research systems.

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The work referenced in this publication is the result of the collective efforts of the volunteers of the IgR Commission of RAICEX and all the authors of the White Paper.

Author Contribution

Author 1: Conceptualization; Data curation; Investigation; Methodology; Visualization; Writing – original draft.

Author 2: Formal analysis; Validation; Writing – review & editing.

Tools of Artificial Intelligence

ChatGPT was used for language editing.

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Social Representations of Women Entrepreneurs in Lithuanian Internet Media

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Abstract: This study examines how Lithuanian internet media construct social representations of women entrepreneurs and whether these representations reinforce or challenge gendered entrepreneurial norms. Guided by Social Representations Theory, the research analyses 24 media texts published between 2019 and 2024, including online news, business publications, and social media, using qualitative content analysis and critical discourse analysis. The findings reveal ambivalent portrayals: women's competence is recognized, but entrepreneurial success is frequently framed through exceptional, individualized, or stereotypical narratives rather than as a normal economic activity. Leadership is presented as relational, while work-life balance remains a gendered expectation. The study is limited by its qualitative design and relatively small sample of media texts from Lithuania. The findings suggest that media discourse simultaneously increases women's visibility while reinforcing traditional gender norms that constrain entrepreneurial legitimacy.

Keywords: Social representations; women entrepreneurs; media discourse; gender and entrepreneurship; leadership representation.

Introduction

Gender equality is one of the fundamental principles of democracy, social justice, and sustainable economic development. It involves not only equal rights for women and men, but also equal opportunities to participate in social, economic, and political life without discrimination. Although significant progress has been made in many European Union countries, inequality in the labour market, particularly in management and business positions, still persists. Lithuania ranks 7th in Europe in terms of opportunities for women to participate in the labour market, and the number of women in management roles has been increasing in recent years. However, top-level decision-making positions remain more difficult for women to attain, often due to social and cultural factors rather than differences in competence. Women in Lithuania

also face challenges such as gender stereotypes and difficulties balancing professional and personal life, while their achievements in business are sometimes evaluated differently than those of men. Such differences in assessment contribute to the unequal visibility, recognition, and authority of women and men in society. Nevertheless, positive changes are also being recorded in the country. According to a study of the European Institute for Gender Equality (EIGE), Lithuania scored 5.67 out of 10 on the overall gender equality index (European Institute for Gender Equality, 2023). These results show that although progress in gender equality is evident, existing structural barriers still limit women's opportunities to participate fully in top-level leadership and decision-making. In Lithuania, despite relatively favourable conditions for women's participation in the labour market and the growing number of female entrepreneurs, their leadership roles are still often interpreted through gender stereotypes. The media plays a significant role in shaping these perceptions, as it not only reflects social reality but also contributes to constructing dominant ideas about what a "successful" woman in business should look like. Media representations frequently emphasize women's personal characteristics, appearance, or family roles rather than their professional achievements or strategic decisions. Such portrayals reinforce simplified gender roles and frame women's leadership as an exception rather than a norm.

The research aim is to analyse how female entrepreneurs and managers are portrayed in the Lithuanian internet media. By integrating Social Representations Theory with media discourse analysis, this study contributes to gender and entrepreneurship research by demonstrating how media discourse constructs symbolic legitimacy for women entrepreneurs through three recurring representational strategies: exceptionalism, moral entrepreneurship, and relational leadership.

Literature Review

Scientific literature extensively analyses gender differences in the entrepreneurship and leadership, but it is increasingly emphasized that these differences cannot be explained solely by structural factors such as education, work experience, or access to financial resources. Although women's educational attainment is equal to or even higher than that of men in most countries, and their participation in the labour market is steadily increasing, the gender gap in leadership positions and business development remains significant (EIGE, 2023; OECD, 2022). Research shows that gender differences in leadership and entrepreneurship are increasingly linked to cultural factors such as social expectations, gender stereotypes, and different perceptions of the legitimacy of women's and men's activities (Marlow & Martinez, 2018; Jennings & Brush, 2019). Empirical data also confirm that there are no statistically significant differences between women and men in their ability to perform quick tasks and overall leadership effectiveness (Paustian-Underdahl et al., 2014; Hoobler et al., 2018). However, gender differences are more

common in decision-making styles and behavioural expressions, especially when making strategic decisions and acting in conditions of uncertainty. Female leaders are more likely to demonstrate behaviour that emphasises relationships and cooperation, while men are more likely to emphasise task and action performance (Eagly & Heilman, 2016). It has also been noted that emotional expression and reactions to negative situations may differ according to gender, but these differences are more related to socialisation and organisational norms than to innate abilities (Hyde, 2014).

There are persistent gender differences in leadership, business growth, and innovation. Empirical studies show that women in business and leadership positions are more likely to encounter invisible, symbolic barriers that limit their opportunities to grow, innovate, and be recognized as equal business leaders (Brush et al., 2019). However, researchers emphasize that these differences are not due to a lack of competence or ambition on the part of women. On the contrary, women often operate in an environment where their entrepreneurship is viewed with more scepticism and their decisions are more often questioned. This situation leads not only to objective limitations on their activities, but also to subjective self-assessment, which can influence strategic business decisions.

Overall, the findings suggest that gender differences in entrepreneurship cannot be attributed solely to structural factors such as education or experience, but are strongly influenced by cultural norms, stereotypes, and perceptions of legitimacy. Persistent gender gaps in leadership and business growth are therefore linked to invisible structural and symbolic barriers, created by media rather than differences in ability or ambition.

In contemporary society, the media plays a significant role in shaping social understandings of norms, roles, and stereotypes, often in implicit ways. Many experts point out that the images and stories we see in the media are usually presented as if they are completely objective and obvious truths. However, in reality, they are shaped by social and cultural influences that colour how things are portrayed (Couldry, 2012). When it comes to how entrepreneurs are shown in the media, there is a noticeable gender bias. Men are often depicted as logical, strategic, innovative, and focused on growth. Women entrepreneurs, on the other hand, are frequently portrayed through a different lens—emphasizing their personal qualities, emotionality, appearance, or family roles (Sundermeier, 2024). This portrayal influences how we perceive men and women in the business world, often reinforcing traditional gender stereotypes.

Media framing of entrepreneurship significantly shapes public perceptions of gender in business. In Lithuania, media representations of women often highlight achievements only when they are connected to social or lifestyle themes, such as being a “mom-entrepreneur” or adapting a business during the pandemic, whereas business growth strategies or financial success are more frequently associated with male-led companies (Mažonaitė, 2022). These

gendered narratives emphasise personal traits, relationships, and social contexts for women, while men are portrayed in terms of strategic decisions and measurable business outcomes (Marlow & Martinez Dy, 2018; Gill, 2007).

Despite the relatively balanced representation of women and men in Lithuania's overall workforce, a persistent gender gap remains in business management and ownership. To assess whether media representations correspond to the actual gender distribution in business leadership, this study examines Lithuanian labour market statistics (see Fig. 1).

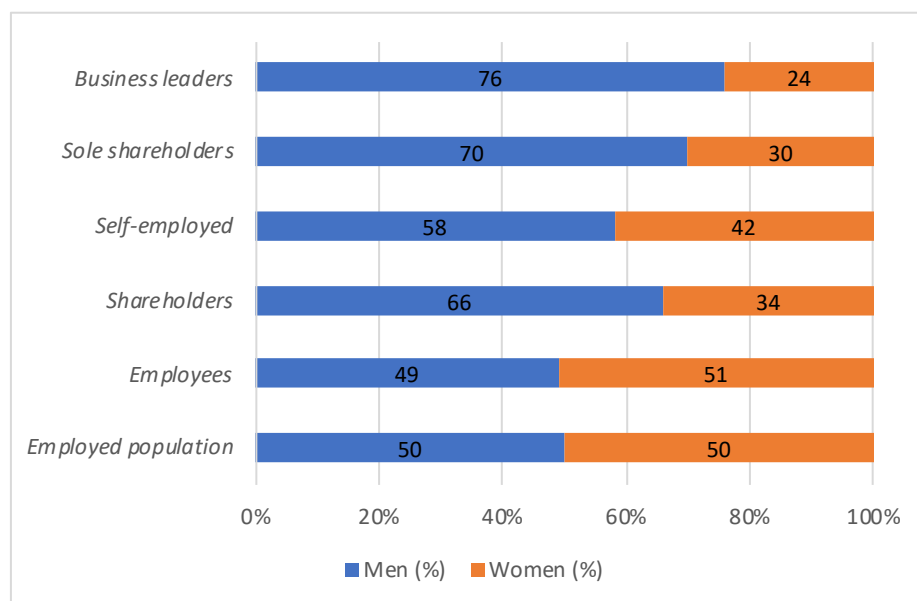


Fig. 1. Statistics on men and women in the Lithuanian labour market, 2024 (source: State Data Agency, 2024. Women and men in Lithuania 2024. State Data Agency. <https://osp.stat.gov.lt>)

The data presented in Fig. 1 reveals that men constitute the absolute majority in business decision-making positions: they account for about two-thirds of all company owners and as much as 70% of sole shareholders. Meanwhile, women account for less than one-third of these positions, and only 24% of all company managers are women in top-level management positions. The figure also shows that although women are actively involved in the labor market as employees and self-employed workers, their participation decreases as they move up the hierarchy towards strategic decision-making and control functions. In summary, the media representation of entrepreneurship and gender is a socially constructed process shaped by prevailing gender norms, power relations, and media logic.

Social representation theory (SRT) explains how collective meanings and social knowledge are created, shared, and maintained through communication and discourse (Lo Monaco et al., 2017). It highlights how social reality shapes what is perceived as legitimate, normal, or desirable behavior. In entrepreneurship research, SRT enables analysis of how media narratives influence the perception and evaluation of female and male entrepreneurs.

Three key SRT concepts are particularly relevant: anchoring, objectification, and normative boundaries.

Anchoring refers to interpreting unfamiliar phenomena by linking them to existing cultural categories and shared meanings (Lo Monaco et al., 2017; Sammut et al., 2015). In Lithuanian media discourse, women's entrepreneurship is often framed through familiar social roles, such as the "mother-entrepreneur" or crisis-adaptive entrepreneur, positioning women's success as exceptional rather than typical.

Objectification involves transforming abstract phenomena into concrete and recognizable symbols (Lo Monaco et al., 2017). Media representations often objectify women entrepreneurs through personal narratives, photographs, or stereotypical imagery, reinforcing their portrayal as different from the conventional entrepreneur.

Normative boundaries define socially acceptable limits of identity and achievement within a cultural context (Sundermeier, 2024; Lo Monaco et al., 2017). Media narratives frequently construct the "typical entrepreneur" using masculine traits such as rationality, competitiveness, and decisiveness, implicitly positioning women's entrepreneurial success as outside the norm.

Although previous studies have examined gender stereotypes in entrepreneurial discourse (Marlow & Martinez Dy, 2018; Jennings & Brush, 2019), limited research has explored how media narratives shape symbolic legitimacy within entrepreneurial ecosystems. This gap is particularly evident in smaller European economies. This study addresses this issue by analyzing representations of women entrepreneurs in Lithuanian media using social representation theory.

Methodology

This study employs a qualitative research methodology to explore how women entrepreneurs are portrayed within Lithuanian media discourse, and to understand how these portrayals influence the construction of entrepreneurial legitimacy, leadership, and gender norms. A qualitative approach is particularly appropriate for this investigation, as it enables a nuanced examination of the underlying meanings, symbolic frameworks, and interpretive patterns present in media texts—focusing on their qualitative richness rather than simply quantifying frequencies or establishing causal links. The empirical foundation of this research comprises 24 media texts sourced from Lithuanian online platforms. These include articles from prominent national news portals, specialized business media outlets, and selected social media pages that blend lifestyle and business content. Collectively, these sources represent the dominant narratives through which women entrepreneurs are made visible to the wider public. The selection

process was guided by purposeful sampling, aligned with the specific goals of the study. Texts were included if they:

1. explicitly focused on women entrepreneurs, founders, or business leaders;
2. discussed entrepreneurship, leadership, innovation, or business development as a central theme;
3. were published by widely accessible and influential Lithuanian media outlets; and
4. contained narrative or descriptive elements allowing for qualitative interpretation (e.g., interviews, personal accounts, reflective commentary).

The timeframe of the data spans 2019–2024, a period marked by heightened public attention to women's entrepreneurship, sustainability, innovation ecosystems, and leadership visibility in Lithuania. This timeframe enables the analysis to capture contemporary discursive patterns, while remaining sufficiently delimited to allow for close reading and contextual interpretation. The final data represents diverse entrepreneurial fields, including technology startups, education, sustainability-oriented ventures, creative industries, and business networks. This diversity supports comparative interpretation across sectors while maintaining a coherent analytical focus on gendered representations of entrepreneurship. The analysis combines Qualitative Content Analysis (QCA) and Critical Discourse Analysis (CDA) to examine both thematic structures and the deeper symbolic meanings of media representations. This approach enables the identification of dominant themes while also addressing power relations, normative assumptions, and gendered discursive practices.

First, qualitative content analysis was conducted using an iterative coding process. A word cloud was used to visualize the most frequent concepts in the analysed media texts (see Fig. 2). The size of each word reflects its frequency, highlighting key themes such as business, women, growth, leadership, networks, innovation, and community. These terms represent the main narratives through which women's entrepreneurship and leadership are portrayed in Lithuanian media discourse.



Fig 2. Word cloud of dominant concepts in Lithuanian media narratives about women entrepreneurs (source: created by the authors using WordCloud)

An initial coding framework was developed deductively, based on the research questions and existing literature on gender and entrepreneurship. Core analytical categories included:

- leadership competence,
- innovation,
- work–life balance,
- emotionality,
- entrepreneurial legitimacy.

The coding process involved two stages. First, open coding identified recurring themes related to leadership, innovation, emotionality, work–life balance, and legitimacy. Second, axial coding grouped these themes into broader symbolic frames. Coding was conducted at the level of meaningful text segments, with attention to both the topics discussed and their framing.

Second, critical discourse analysis was applied to examine how language and narrative structures construct gendered entrepreneurial identities. Following CDA principles (Fairclough, 2020; Wodak & Meyer, 2019), the analysis focused on:

1. symbolic frames such as exceptionalism, moral entrepreneurship, relational leadership, and resilience;
2. implicit norms related to gender, leadership, and success;
3. legitimizing and delegitimizing discursive strategies.

Reflexivity was maintained throughout the analysis. The researcher reflected on interpretative choices and potential biases, documenting insights through analytical memos to ensure transparency.

The study relies exclusively on publicly available media texts and does not involve direct interaction with human participants. Therefore, formal ethical

approval was not required. Nevertheless, ethical principles guided the analysis, and quotations were used solely for analytical purposes. The focus remained on discursive patterns rather than individual evaluations.

Results

The analysis shows that women entrepreneurs are highly visible in Lithuanian media; however, this visibility is selective and narratively framed. Women most frequently appear in interviews, feature stories, inspirational profiles, and award-related coverage rather than in routine economic reporting. As a result, entrepreneurship is often presented through personal stories rather than through structural discussions of business ecosystems. Across the corpus, five dominant themes emerged: leadership competence, innovation, entrepreneurial legitimacy, work-life balance, and emotionality (see Table 1).

Table 1. Dominant Themes in Media Representations of Women Entrepreneurs

Theme	What the theme does in the text (QCA interpretation)	Typical linguistic markers / examples
Leadership competence	Competence is often framed as process competence (organising, implementing, maintaining balance) and relational competence (communicating vision, enabling others), rather than “strategic authority” as an abstract leadership ideal.	“clear communication of what the organisation wants” and the leader as implementer; leadership competence equated with prioritising and balancing.
Innovation	Innovation is presented in two ways: (1) technical/product innovation (energy software, growth metrics) and (2) social/educational innovation (sustainability academy, skills building). Innovation is frequently anchored to purpose (“impact”, “climate”).	“AI/tech/renewables” + growth language; sustainability education framed as “first”, “holistic”, “community building”.
Work-life balance	Balance is strongly gendered: women’s leadership is repeatedly narrated through family roles and “how she manages”, implying a moral benchmark. Balance becomes a competence in itself.	“4 children... how we managed”; “balancing business and being a mother/wife” framed as leadership competence.
Emotionality	Emotionality is legitimate and visible: portrayed as community affect (belonging, support, hugs, smiles) and as inner feeling (meaning, satisfaction). Emotional register often “softens” entrepreneurship discourse.	“emotions priceless... smiles, hugs”; “different feeling inside” tied to impact/purpose.
Entrepreneurial legitimacy	Legitimacy is built via: (a) awards/recognition (grants, rankings), (b) moral legitimacy (“doing good”, “impact”), and (c) compliance/structural struggle (bureaucracy, regulation). Women’s legitimacy is sometimes achieved through exceptionalism (“first”, “rare”).	“won a stipend”; “Financial Times ranking”; “bureaucratic obstacle course”; “no comparable examples—built it ourselves”.

Leadership (see Table 1) is predominantly framed as relational and process-oriented, emphasizing communication, coordination, and enabling others rather than strategic authority. Innovation appears through two complementary frames: technological innovation (e.g., AI, renewable energy, software solutions) and social innovation (e.g., sustainability education and community development). Entrepreneurial legitimacy is constructed through awards, rankings, grants, and evidence of social impact, while work–life balance and emotionality remain strongly gendered dimensions of representation. Women entrepreneurs are most visible during symbolically significant moments, such as awards, investment milestones, anniversaries, or success stories. Although these narratives increase recognition, they also position women as exceptional examples rather than as ordinary participants in economic life.

Critical discourse analysis identified five dominant symbolic frames shaping media representations (Table 2): exceptional woman, purpose-driven entrepreneur, community-oriented entrepreneur, resilient entrepreneur, and work–family balancing leader.

Table 2. Dominant Symbolic Frames of Women’s Entrepreneurship

Symbolic Frame	Key Characteristics	Discursive Function
Exceptional entrepreneur	First, unique, pioneer	Legitimizes success but reinforces rarity
Purpose-driven entrepreneur	Sustainability, education, impact	Creates moral legitimacy
Community-oriented entrepreneur	Mentorship, support networks	Builds legitimacy through belonging
Resilient entrepreneur	Overcoming obstacles and uncertainty	Success justified through perseverance
Work–family balancing leader	Professional and family responsibilities	Reinforces gendered expectations

The most prominent frame is that of the exceptional entrepreneur, where women are portrayed as pioneers, innovators, or “first movers.” Such narratives strengthen legitimacy but simultaneously reinforce the perception that women’s entrepreneurial success is unusual rather than normalized. Similarly, purpose-driven entrepreneurship links business activity to sustainability, education, and social impact, creating moral legitimacy beyond financial performance.

A second recurring frame emphasizes relationships, mentoring, and community building. Entrepreneurial success is frequently associated with belonging, collaboration, and mutual support rather than with individual competition. At the same time, narratives of resilience portray success as the outcome of overcoming adversity, bureaucratic barriers, and organisational challenges. These stories legitimize entrepreneurial achievement through endurance and perseverance.

Further findings reveal that women's entrepreneurship is interpreted through gendered narrative logics (Table 3). Leadership competence is commonly represented as enabling, coordinating, and implementing rather than as visionary or authoritative leadership. Although women are recognized as capable leaders, the archetype of the strategic entrepreneur often remains implicitly masculinized.

Similarly, innovation is represented differently depending on context. In technology-oriented ventures, legitimacy is frequently reinforced through external validation such as rankings, investments, and international recognition. In contrast, sustainability and educational initiatives are framed through purpose, care, and social contribution. This distinction reproduces a subtle divide between a masculinized “hard innovation” discourse and a feminized “impact innovation” discourse.

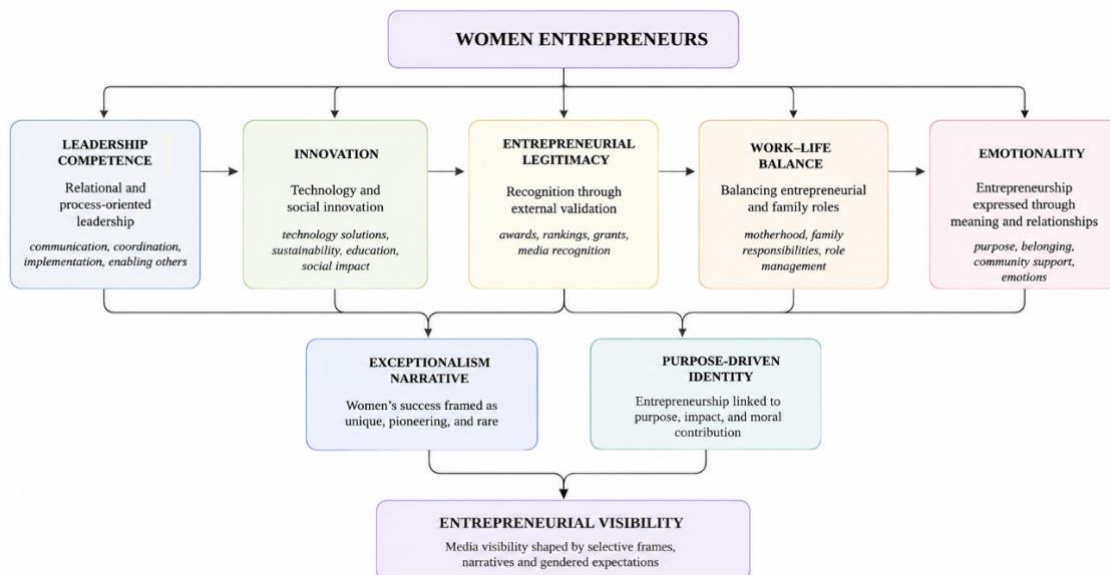


Fig. 3. Gendered Narratives in Entrepreneurial Discourse (created by the authors)

A central finding concerns the prevalence of exceptionalist success narratives. Women entrepreneurs are frequently portrayed as resilient individuals who overcome obstacles through determination, courage, and personal commitment. While these narratives celebrate achievement, they simultaneously obscure structural factors such as access to resources, institutional support, or market conditions. Consequently, entrepreneurial success is individualized and personalized rather than contextualized within broader economic structures.

In summary, findings suggest that women entrepreneurs are increasingly visible and positively represented in media discourse. However, their visibility remains mediated by gendered frames emphasizing exceptionalism, moral legitimacy, relationality, and work–family balance. As a result, women’s

entrepreneurial achievements are often recognized through narrative distinction rather than normalized as a routine part of entrepreneurial activity.

Discussion

The findings support previous research showing that media representations of women entrepreneurs remain gendered despite increasing female participation in entrepreneurship (Marlow & Martinez Dy, 2018; Jennings & Brush, 2019). Similar to earlier studies, Lithuanian media emphasize women's personal characteristics, resilience, family responsibilities, and social contribution rather than presenting them as ordinary economic actors. This confirms that entrepreneurial legitimacy continues to be constructed through symbolic rather than purely economic criteria.

From the perspective of Social Representations Theory, media narratives anchor women entrepreneurs to familiar cultural identities, including the caring leader, the resilient pioneer, and the purpose-driven entrepreneur. While these representations increase public visibility, they also reproduce normative expectations that distinguish women from the implicit masculine entrepreneurial prototype.

The Lithuanian context illustrates this paradox particularly well. Although women actively participate in the labour market and entrepreneurship, they remain underrepresented among business owners and top executives. Consequently, media visibility alone does not normalize women's entrepreneurial leadership but may instead reinforce exceptionalist narratives.

These findings contribute to entrepreneurship and media studies by demonstrating how symbolic legitimacy is constructed through discourse. They also suggest that future media communication should increasingly portray women entrepreneurs as routine economic actors rather than exceptional success stories.

Conclusions

This study examined how women entrepreneurs are represented in Lithuanian online media and how these representations shape perceptions of entrepreneurship, leadership, and gender. Drawing on social representations theory and combining qualitative content analysis with critical discourse analysis, the research analysed 24 media texts published between 2019 and 2024. The findings reveal a pattern of ambivalent recognition: women entrepreneurs are visible and their achievements are acknowledged, yet their legitimacy is often framed through narratives that distinguish them from the implicit entrepreneurial norm.

The analysis shows that women entrepreneurs appear regularly in Lithuanian media, but their visibility is selective and narratively structured. They are most often presented in personal profiles, inspirational interviews, or celebratory coverage rather than in routine economic reporting. This positioning frames women entrepreneurs primarily as subjects of personal stories rather than as ordinary actors within economic systems. Consequently, their activities are frequently portrayed as illustrative examples of success rather than normalized forms of economic participation.

The findings also highlight the prevalence of exceptionalist success narratives. Media texts frequently describe women entrepreneurs as pioneers or extraordinary individuals who succeed through resilience, determination, and personal courage. While such narratives validate women's achievements, they simultaneously reinforce the perception that women's success is unusual. From the perspective of social representations theory, exceptionalism enables recognition of women's accomplishments while maintaining the implicit association between entrepreneurship and masculine leadership.

Women's entrepreneurial legitimacy is also often constructed through moral and relational frames. Media narratives link women entrepreneurs to purpose-driven initiatives such as sustainability, education, and social impact, while their leadership is described through collaboration, mentoring, and community building. These representations broaden the meaning of entrepreneurship by highlighting responsibility and social contribution. However, they may also reinforce a gendered distinction between a masculinized entrepreneurial ideal associated with competition and scale and a feminized model linked to care and relational leadership. Media narratives frequently emphasize work-life balance, portraying women entrepreneurs as balancing business leadership with family responsibilities. Although such stories humanize entrepreneurial work, they introduce expectations rarely applied to male entrepreneurs.

Overall, Lithuanian media discourse simultaneously recognizes and constrains women entrepreneurs. While women are celebrated as innovators and changemakers, their success is often framed through exceptional or relational narratives rather than normalized as a standard entrepreneurial role. These findings suggest that increasing media visibility alone may not transform dominant entrepreneurial norms, as media representations can simultaneously enhance recognition and reproduce symbolic gender inequalities.

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Author Contribution

Conceptualization, M.E. Černikovaitė and D. Lunienė; methodology, M.E. Černikovaitė; formal analysis, M.E. Černikovaitė; investigation, M.E. Černikovaitė and D. Lunienė; writing—original draft preparation, M.E. Černikovaitė; writing—review and editing, M.E. Černikovaitė and D. Lunienė. All authors have read and agreed to the published version of the manuscript.

Tools of Artificial Intelligence

Artificial intelligence tools were used solely to improve language clarity and grammar during manuscript preparation. All conceptual development, data analysis, interpretation of findings, and final editorial decisions were performed by the authors, who take full responsibility for the content of the manuscript.

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Arts-Based Futures Literacy in Primary Education: A Female-Led Practice-Oriented Research Positioning from Kochi, India

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Abstract: This paper presents a conceptual and methodological positioning of a female-led practice-oriented research initiative exploring arts-based futures literacy in primary education. Anchored in UNESCO's concept of Futures Literacy, the study examines how participatory arts practices can support children aged 6–12 in imagining plural futures while strengthening anticipatory capacities. The research is situated within a transdisciplinary collaboration between Erasmus Brussels University of Applied Sciences and Arts (Belgium), Rajagiri College of Social Sciences, and The Art Outreach Society in Kochi (India). Using Participatory Action Research (PAR), the project combines arts-based workshops, storytelling, and food-related cultural practices as entry points to futures thinking. Rather than focusing on measurable outcomes, the study foregrounds capacity-building processes through which imagination, agency, and collective reflection emerge. Positioned within feminist epistemology, the article argues that women-led facilitation and care-oriented pedagogies shape how futures knowledge is produced.

Keywords: Futures literacy; arts-based education; participatory action research; feminist epistemology; intergenerational futures.

Introduction: Women as Knowledge Producers in Futures-Oriented Education

The production of scientific knowledge has historically been shaped by gendered structures that privilege certain voices while marginalizing others. Although the participation of women in academic research has increased significantly in recent decades, gender inequalities persist in terms of recognition, leadership positions, and epistemic authority (Harding, 1991; Rolin, 2009). Conferences such as the Women in Science International Conference therefore emphasize the importance of recognizing women not merely as participants in scientific discourse but as active producers of knowledge who contribute to shaping intellectual paradigms, methodological approaches, and research practices across disciplines.

Within futures studies, questions of epistemic inclusion become particularly significant, as the ways futures are imagined, analysed, and communicated inevitably reflect broader social and cultural power relations. Historically, futures research has often been dominated by technocratic and policy-oriented approaches focused on forecasting, modelling, and strategic planning (Slaughter, 1995; Bell, 2003). While such approaches have generated valuable insights, they frequently privilege expert-driven perspectives and overlook the imaginative, cultural, and relational dimensions through which societies collectively engage with the future. In response, scholars increasingly advocate more participatory and pluralistic approaches to futures thinking that recognize the importance of diverse voices, situated knowledge, and collective imagination. Within this evolving landscape, UNESCO's concept of Futures Literacy represents a particularly important development. Futures Literacy refers to the capacity to understand and use the future in order to inform present action (Miller, 2018), emphasizing that the future should not be understood as a fixed destination to be predicted but as a conceptual resource that expands present possibilities for thought and action. Despite growing international interest in Futures Literacy, its integration into formal education systems remains limited. Educational curricula continue to emphasize retrospective knowledge acquisition and standardized assessment while leaving comparatively little room for anticipatory thinking and speculative exploration (OECD, 2018). This gap becomes particularly significant in contexts characterized by rapid social, environmental, and technological transformation, where the ability to engage creatively with uncertainty becomes increasingly essential.

The practice-oriented research initiative presented in this article seeks to address this challenge by exploring how arts-based pedagogical practices can support the development of futures literacy in primary education. The project forms part of the broader research trajectory *Art as a Catalyst for Futures Literacy towards Resilient Community*, conducted by the Research Centre OPEN Arts & Futures at Erasmus Brussels University of Applied Sciences and Arts in collaboration with Rajagiri College of Social Sciences, and The Art Outreach Society in Kochi, India. Through participatory arts practices, collaborative storytelling, and futures-oriented workshops, the project aims to embed futures literacy within educational and civic contexts while creating spaces where children, educators, artists, and researchers can collectively explore alternative futures. Importantly, and perhaps unsurprisingly given the conference context, the research environment within which this work unfolds is predominantly female-led, involving women researchers, educators, and cultural practitioners who co-develop and facilitate the workshops. While gender itself is not the explicit object of investigation, the project nevertheless raises questions regarding how gendered forms of facilitation, care, and collaboration may shape the production of knowledge about the future. The article therefore positions the project at the intersection of futures studies, arts-based inquiry, participatory action research, and feminist epistemology, arguing that arts-based futures literacy practices offer a promising pathway for cultivating anticipatory capacities while broadening the diversity of voices participating in futures discourse.

Futures Literacy and Arts-Based Inquiry

The concept of Futures Literacy has emerged as one of the most influential frameworks within contemporary futures studies. Developed within the UNESCO Futures Literacy initiative, it emphasizes the capacity of individuals and societies to use the future(s) as a resource for understanding and shaping the present (Miller, 2018). In doing so, Futures Literacy shifts the focus of futures research away from prediction and control toward the cultivation of anticipatory capabilities that allow individuals and communities to engage more reflexively with uncertainty and complexity. Central to this perspective is the recognition that the future does not exist as a predetermined reality waiting to be discovered. Rather, futures emerge through cultural imaginaries, social expectations, institutional frameworks, and collective decision-making processes that shape how individuals and societies orient themselves toward what lies ahead. Anticipation therefore becomes not merely a technical exercise but a fundamentally social and cultural practice. Anticipatory systems theory similarly highlights how societies continuously generate expectations about the future that influence present behaviour and decision-making (Poli, 2010).

In the domain of futures studies, one widely used conceptual model for exploring such dynamics is the Futures Cone, which visualizes a spectrum of possible, plausible, probable, and preferable futures (Voros, 2017). As illustrated in Fig. 1, the Futures Cone highlights how the future should be understood not as a single trajectory but as a field of expanding possibilities shaped by social choices, cultural imaginaries, and institutional dynamics.

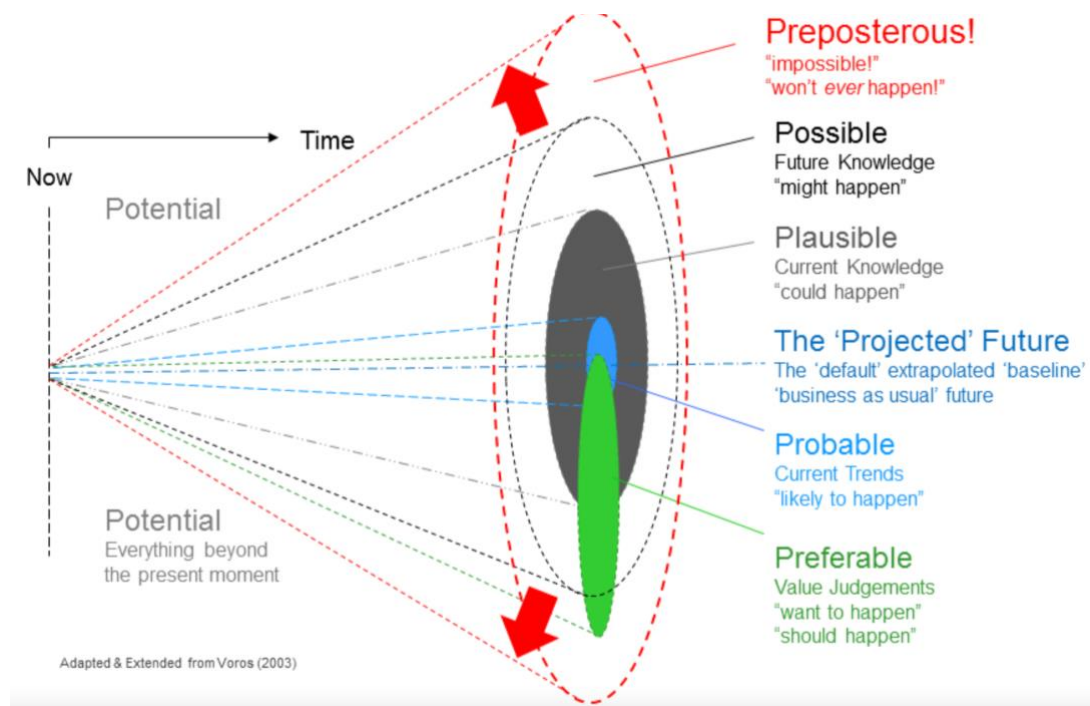


Fig. 1. Futures Cone illustrating multiple trajectories of possible futures (adapted from Voros, 2017)

Rather than presenting the future as a linear pathway, this model illustrates how multiple futures coexist simultaneously as potential trajectories shaped by different assumptions, choices, and contextual developments. Engaging with this multiplicity allows individuals and organizations to question implicit narratives of inevitability and explore alternative possibilities that might otherwise remain obscured.

Inside educational contexts, futures literacy can therefore support the development of key competencies such as imagination, critical thinking, and agency. The OECD's *Future of Education and Skills 2030* initiative similarly emphasizes the importance of equipping learners with the ability to navigate uncertainty and engage creatively with complex global challenges (OECD, 2018). Translating futures literacy into educational practice, however, presents significant pedagogical challenges. Traditional educational models often prioritize standardized knowledge transmission and measurable learning outcomes, leaving limited space for exploratory and speculative learning processes. Within this context, arts-based approaches offer particularly valuable methodological possibilities.

Within this research, “arts-based” practices encompass a combination of visual (plastic) arts (e.g., drawing and image-making), narrative forms (e.g., storytelling), performative elements (e.g., role-play and embodied exercises), and, where relevant, audiovisual and culturally embedded practices (e.g., food-related storytelling and collective rituals). These modalities are not treated as separate disciplines but as interconnected forms of expression through which participants explore and articulate possible futures. Arts-based research has gained increasing recognition as a legitimate mode of inquiry within the social sciences and humanities, precisely because artistic practices allow researchers and participants to engage with complex social phenomena in ways that extend beyond conventional analytical frameworks. Eisner (2002) argues that artistic processes can generate forms of knowledge difficult to capture through traditional methods, enabling participants to express emotions, experiences, and imaginaries that may remain inaccessible within purely verbal or quantitative research paradigms. Building on this perspective, Barone and Eisner (2012) suggest that arts-based research functions both as a method of inquiry and as a mode of representation through which creative experimentation and interpretation produce new forms of understanding. In the context of futures literacy, such artistic practices provide a particularly powerful entry point into anticipatory thinking. Drawing, storytelling, performance, and other creative activities allow participants to explore potential futures in ways that are imaginative, embodied, and socially collaborative, creating spaces where speculative thinking can emerge through shared creative engagement. As illustrated in Fig. 2, arts-based futures literacy practices may be understood as a dynamic process linking cultural memory, present meaning-making, and imaginative projection.



Fig. 2. Relationship between cultural memory, present meaning-making, and future imagination in arts-based futures literacy practices

Within this framework, cultural memory functions not as a static archive of the past but as an active resource through which participants reinterpret the present and expand the futures they are able to imagine. Working with children further highlights the importance of such approaches. Developmental research suggests that children possess remarkable capacities for imaginative thinking and speculative reasoning closely linked to play, creativity, and narrative exploration (Vygotsky, 1978). During the primary school years, cognitive development remains deeply intertwined with these creative processes, making artistic and narrative methods particularly appropriate for exploring complex concepts such as the future.

Consequently, arts-based futures workshops can create environments in which children experiment with alternative futures while developing critical awareness of their social and environmental contexts. Such practices resonate strongly with UNESCO's broader vision of futures literacy as a collective capacity emerging through dialogue, imagination, and shared reflection.

Participatory Action Research and Gendered Facilitation

The methodological framework of the present project is grounded in Participatory Action Research (PAR), an approach that emphasizes collaboration between researchers and participants in the co-production of knowledge (Reason & Bradbury, 2008). Emerging from traditions of critical pedagogy, community development, and social justice research, PAR challenges conventional research models that position participants as passive subjects of investigation. Instead, participants become active contributors to the research process, engaging in iterative cycles of action, reflection, and collective learning through which challenges are identified, interventions explored, and insights generated that are both theoretically meaningful and socially relevant.

In educational contexts, PAR offers particular advantages, as it enables teachers, students, and community members to participate directly in shaping the research process. By fostering a sense of ownership and agency among participants, PAR supports learning environments that encourage experimentation, dialogue, and critical reflection – dynamics that become especially relevant when exploring futures literacy, which inherently involves questions of collective decision-making, social imagination, and the capacity to envision alternative societal trajectories. In our Kochi project, PAR is operationalized through a series of arts-based futures workshops conducted

with primary school children. Drawing exercises, storytelling activities, and collaborative discussions invite participants to imagine different possible futures. Rather than treating children as passive recipients of knowledge, these workshops position them as co-creators of futures narratives, allowing their drawings, stories, and reflections to function simultaneously as research material and as catalysts for collective learning. The methodological emphasis on collaboration also intersects with feminist perspectives on knowledge production. Feminist epistemologists have long argued that traditional research paradigms often reproduce hierarchical relationships between researchers and participants, thereby limiting the diversity of voices that contribute to knowledge creation (Harding, 1991). Feminist approaches therefore emphasize reflexivity, relationality, and the recognition of situated knowledge. Donna Haraway's concept of situated knowledge highlights how all knowledge is produced from specific social positions and experiences (Haraway, 1988). Recognizing these positionalities does not undermine research credibility; rather, it enhances transparency and encourages greater reflexivity regarding the conditions under which knowledge emerges. In Kochi, the facilitation of workshops is predominantly carried out by women researchers, educators, and arts practitioners. Although this gender composition was not initially conceived as a research variable, it nevertheless shapes the dynamics of the research environment in meaningful ways. Care-oriented pedagogical practices often play a central role in these interactions. Feminist care ethics emphasizes relational responsibility, empathy, and attentiveness within social relationships (Tronto, 1993), suggesting that educational practices grounded in care can create environments that encourage creativity, trust, and open dialogue. Such conditions may be particularly conducive to futures-oriented learning, where participants are invited to articulate hopes, fears, and uncertainties about possible worlds. A supportive and collaborative environment therefore becomes essential in enabling participants to engage fully in speculative exploration and collective reflection.

The Transdisciplinary Research Triangle: EhB - Rajagiri - TAOS

The practice-oriented research presented in this article is embedded within a transdisciplinary collaboration connecting three institutional contexts: (1) the Research Centre for OPEN Arts & Futures at Erasmus Brussels University of Applied Sciences and Arts (Belgium), (2) Rajagiri College of Social Sciences in Kochi (India), and (3) The Art Outreach Society (TAOS), a community-based arts organization also located in Kochi. Together, these partners form what may be described as a research-practice-community triangle in which academic expertise, educational practice, and socially engaged artistic facilitation converge in the co-development of futures literacy initiatives.

Transdisciplinary collaboration has become increasingly important in futures-oriented research, particularly when addressing complex societal challenges that cannot be adequately understood through a single disciplinary lens.

Scholars such as Nicolescu (2014) and Klein (2017) emphasize that transdisciplinary research goes beyond interdisciplinary integration by actively involving practitioners and stakeholders outside academia in the co-production of knowledge. Within this framework, research is no longer conceived as a linear transfer of expertise from scholars to society but as a collaborative process in which diverse forms of knowledge interact in the exploration of shared questions. The present project reflects this orientation by positioning artistic practice, educational engagement, and futures research as mutually reinforcing domains of inquiry. At Erasmus Brussels University of Applied Sciences and Arts, the initiative is anchored within the Research Centre for OPEN Arts & Futures, whose research agenda focuses on participatory arts practices, civic imagination, and futures-oriented cultural experimentation. This institutional environment provides the conceptual and methodological foundation for the project through its engagement with futures literacy, arts-based research, and participatory approaches to knowledge creation. Rajagiri College of Social Sciences contributes a strong pedagogical and social work perspective, supported by its longstanding engagement with community-based education and participatory learning methodologies in Kerala. Through its networks with schools, educators, and local stakeholders, Rajagiri plays an important role in ensuring that the project remains closely aligned with educational practice and community realities. The Art Outreach Society (TAOS) provides a third essential dimension. As a socially engaged arts initiative with extensive experience working with youth and communities across Kochi, TAOS facilitates participatory artistic processes that allow young participants to express their perspectives and engage creatively with their social environments. Within the project, TAOS plays a central role in organizing arts-based workshops and ensuring that the creative processes remain culturally grounded and accessible.

The interaction between these three partners generates a hybrid research environment in which academic inquiry, educational experimentation, and artistic practice intersect. Rather than operating as separate domains, these spheres become mutually constitutive elements of the research process. Artistic activities function not merely as tools of dissemination but as core methodological components through which futures imaginaries are explored and articulated. Through this collaborative structure, workshops with children become focal spaces where these different forms of expertise converge. Researchers contribute conceptual frameworks related to futures literacy and participatory inquiry, educators bring pedagogical insights into children's learning processes, and artists facilitate creative activities that allow speculative thinking to emerge through drawing, storytelling, and collective reflection.

Such interactions illustrate the potential of transdisciplinary research to generate situated knowledge emerging from practice rather than from abstract theoretical speculation alone. As Gibbons et al. (1994) argue in their discussion of "Mode 2" knowledge production, contemporary research increasingly unfolds in contexts where academic and societal actors collaborate to address complex problems, producing knowledge that is both context-sensitive and socially distributed. The triangular collaboration

between EhB, Rajagiri, and TAOS therefore exemplifies a form of practice-based futures research in which the boundaries between research, pedagogy, and cultural practice become intentionally porous. By working across institutional and cultural contexts, the project creates conditions in which futures literacy can be explored not only as a theoretical concept but also as a lived practice emerging through collective experimentation.

Feminist Epistemology and Anticipatory Capacity

While the primary focus of the project lies in exploring futures literacy through arts-based educational practices, its collaborative structure also raises broader epistemological questions concerning the relationship between gender and knowledge production. Feminist epistemology provides a particularly useful framework for examining these dynamics, as it foregrounds the ways in which knowledge is shaped by social positions, institutional structures, and relational practices. Feminist scholars have long argued that traditional conceptions of scientific objectivity often obscure the situated nature of knowledge production. Harding (1991) and Haraway (1988), for instance, emphasize that all knowledge emerges from specific historical, cultural, and social contexts. Recognizing these contexts does not undermine the credibility of research; rather, it enables more reflexive and inclusive forms of inquiry. In the present project, gender does not function as the central research variable. Nevertheless, the research environment is predominantly female-led, involving women researchers, educators, and arts practitioners across all partner institutions. This configuration invites reflection on how gendered practices of collaboration, facilitation, and care may shape the ways futures knowledge is produced and shared.

Feminist scholarship on the ethics of care offers a particularly relevant lens in this regard. Scholars such as Tronto (1993) and Puig de la Bellacasa (2017) argue that care should not be understood merely as a private moral virtue but as a fundamental dimension of social and political life. Care-oriented practices emphasize attentiveness, relational responsibility, and the recognition of interdependence between individuals and communities. Within educational settings, such principles often manifest in pedagogical approaches that prioritize dialogue, empathy, and collaborative learning, creating environments in which participants feel encouraged to experiment with ideas and engage with uncertainty without fear of failure or judgement.

In futures-oriented research, such relational dynamics become particularly significant. Imagining alternative futures requires participants to articulate hopes, concerns, and uncertainties about the worlds they inhabit and the worlds they might wish to create. These reflections are often deeply personal and socially embedded, making supportive and collaborative environments essential for meaningful engagement. Embedded in the workshops conducted in Kochi, the facilitation practices adopted by the research team emphasize precisely such relational dynamics. Artistic exercises are designed not as competitive tasks or evaluative assessments but as open-ended invitations to imagine, draw, narrate, and discuss possible futures. The

emphasis lies on collective exploration rather than individual performance, creating space for multiple voices and perspectives to emerge. This orientation resonates with broader feminist critiques of hierarchical knowledge production, which challenge the privileging of expert authority and instead emphasize distributed knowledge emerging through interaction and dialogue.

The intersection between feminist epistemology and futures literacy therefore highlights an important dimension of anticipatory capacity. Anticipation is not simply an individual cognitive skill but a relational and cultural practice that emerges through shared reflection and dialogue. By creating participatory spaces in which diverse voices can engage with speculative thinking, arts-based futures workshops contribute to the development of anticipatory cultures extending beyond traditional expert-driven foresight. The involvement of children as central participants further expands the epistemological horizon of futures studies. Children are often excluded from discussions about the future, despite the fact that they will inhabit the long-term consequences of present decisions. Engaging children in futures-oriented dialogue therefore represents not only a pedagogical innovation but also an ethical commitment to intergenerational inclusion, a perspective that resonates strongly with recent articulations by the European Commission's Joint Research Centre concerning the integration of intergenerational fairness into contemporary policy and research agendas (European Commission, JRC, 2024).

Through drawing, storytelling, and collaborative reflection, children participating in the workshops articulate visions of the future that may diverge significantly from dominant narratives shaped by adult perspectives. These visions often incorporate elements of play, imagination, and everyday experience, thereby expanding the range of possibilities that futures discourse can encompass. From this perspective, the project's arts-based methodology functions not only as a pedagogical tool but also as an epistemic intervention within futures research, foregrounding imagination, relational learning, and participatory dialogue while challenging conventional assumptions about who is entitled to contribute to knowledge about the future.

Discussion

The conceptual and methodological positioning presented in this article highlights the potential of arts-based futures literacy practices to expand how anticipatory capacities may be cultivated within educational contexts. Rather than treating futures literacy as a technical skill related to forecasting or prediction, the project situates anticipation within relational, cultural, and creative processes that emerge through dialogue, imagination, and shared exploration. This perspective resonates with broader shifts within futures studies that emphasize plural futures, participatory foresight, and anticipatory governance (Miller, 2018; Poli, 2010). Within such frameworks, anticipation is understood not as a deterministic projection of trends but as a socially

embedded capacity through which individuals and communities reflect on possible trajectories and their implications for present action. Arts-based inquiry offers a particularly valuable methodological pathway for cultivating these capacities. By enabling participants to express ideas through drawing, storytelling, and performative engagement, artistic practices create spaces in which speculative thinking can emerge without the constraints often associated with analytical or evaluative educational formats. This is especially significant when working with children, whose imaginative capacities and narrative sensibilities remain closely intertwined with processes of play and creative exploration (Vygotsky, 1978).

The workshops conducted in Kochi illustrate how arts-based futures literacy practices can create environments where children feel empowered to articulate perspectives on the future that might otherwise remain unheard. Through collaborative exercises, participants reflect on everyday experiences, cultural traditions, and emerging societal challenges while imagining alternative possibilities. In doing so, the workshops not only stimulate individual creativity but also foster collective reflection and mutual learning.

From a methodological perspective, the integration of Participatory Action Research (PAR) further strengthens these dynamics. PAR emphasizes iterative cycles of action, reflection, and adaptation, allowing research processes to evolve in response to participants' insights and experiences (Reason & Bradbury, 2008). Within the Kochi project, this iterative process enables the research team to refine workshop formats, explore emerging themes, and co-develop pedagogical approaches in collaboration with educators and community partners.

The project also contributes to ongoing discussions concerning the role of gender in knowledge production. Although gender is not the primary analytical focus of the study, the predominantly female-led research environment invites reflection on how collaborative and care-oriented facilitation practices may shape research processes and learning environments. Feminist epistemology suggests that such relational practices can expand the range of perspectives recognized as legitimate sources of knowledge (Harding, 1991; Haraway, 1988). Facilitation practices grounded in dialogue, attentiveness, and shared exploration appear to create conditions that support open-ended speculation about the future. Rather than imposing predefined scenarios, the workshops encourage participants to explore diverse possibilities and reflect collectively on their implications, thereby supporting more inclusive forms of anticipatory dialogue.

The involvement of children as active contributors to the research process further expands the epistemological scope of futures studies. Children are often excluded from discussions about the future, despite the fact that they will inhabit the long-term consequences of present decisions. Engaging children in futures-oriented dialogue therefore represents not only a pedagogical innovation but also an ethical commitment to intergenerational inclusion. This perspective resonates with recent articulations by the European Commission's Joint Research Centre concerning the importance of

integrating intergenerational fairness into contemporary research and policy agendas (European Commission, Joint Research Centre, 2024).

Through drawing, storytelling, and collaborative reflection, children participating in the workshops articulate visions of the future that frequently diverge from dominant narratives shaped by adult perspectives. These visions often incorporate elements of play, imagination, and everyday experience, thereby expanding the range of possibilities that futures discourse can encompass.

At the same time, the exploratory nature of the present research should be acknowledged. As a practice-oriented project grounded in Participatory Action Research, the initiative prioritizes capacity-building processes rather than measurable outcomes. The emphasis lies on fostering imaginative engagement, relational learning, and collective reflection rather than on producing standardized indicators of futures literacy. Future research may build on the conceptual and methodological framework presented here by examining how arts-based futures literacy practices evolve over time and how they influence educational practice, community engagement, and policy dialogue across different contexts.

From a broader theoretical perspective, the project also contributes to emerging discussions concerning the development of anticipatory cultures – understood as the social and institutional conditions through which societies collectively imagine, debate, and shape possible futures. Futures literacy initiatives increasingly emphasize that anticipation should not remain confined to expert-driven foresight processes but should instead become a distributed capacity embedded within everyday social practices (Miller, 2018). By integrating artistic expression, participatory research methodologies, and intergenerational dialogue, the project illustrates how arts-based futures literacy practices may contribute to the gradual emergence of more inclusive anticipatory cultures in education and civic life.

Conclusions

This article has presented a conceptual and methodological positioning of a female-led practice-oriented research initiative exploring arts-based futures literacy in primary education. By situating the project at the intersection of futures studies, arts-based inquiry, participatory action research, and feminist epistemology, the study highlights the potential of creative and participatory approaches to expand how anticipatory capacities may be cultivated within educational environments.

Three key insights emerge from this positioning:

First, futures literacy should be understood not merely as a cognitive competence but as a relational and cultural practice that develops through dialogue, imagination, and collective reflection. Artistic practices can play a crucial role in facilitating such processes by creating environments where speculative thinking and creative expression become integral to learning.

Second, participatory methodologies such as Participatory Action Research provide valuable frameworks for exploring futures literacy within educational contexts. By involving participants as co-creators of knowledge, PAR supports learning processes that are adaptive, context-sensitive, and responsive to lived experience.

Third, the project illustrates how gendered dynamics of collaboration and facilitation may shape the ways futures knowledge is produced and shared. Although gender is not treated as the central analytical variable, the predominantly female-led research environment foregrounds relational practices of care, attentiveness, and dialogue that appear particularly conducive to participatory futures exploration.

Taken together, these insights suggest that arts-based futures literacy practices can contribute to the development of more inclusive anticipatory cultures within education and beyond. By engaging children, educators, artists, and communities in collective reflection on possible futures, such practices broaden the range of voices participating in futures discourse and challenge conventional assumptions about who is entitled to imagine and shape the future. In an era characterized by rapid social, technological, and environmental change, cultivating such anticipatory capacities may prove essential not only for education but also for broader societal resilience. Through its emphasis on imagination, participation, and intergenerational dialogue, the project invites continued exploration of how creative and collaborative approaches may contribute to more inclusive and reflexive engagements with the futures we collectively inhabit.

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Author Contribution

Author: Conceptualization, methodology, investigation, writing – original draft preparation, writing – review and editing, visualization, project administration.

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ChatGPT (OpenAI) was used as a language support tool during the drafting process to assist with text refinement and structural editing. All conceptual development, interpretation, and final content decisions remain the responsibility of the author.

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Wandering Gazes: Drifting, Observation and Archiving in the Work of Agnès Varda and Sophie Calle

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Abstract: The text proposes a cross-cutting reading of the artistic practices of Agnès Varda and Sophie Calle based on their shared methodologies. It presents observation as a common method and as a way of producing knowledge in contemporary art. Rather than analyzing specific works, the focus is placed on actions such as looking, moving, following, waiting, collecting, and archiving, understood as forms of research.

In both artists' practices, observation unfolds through drifting and prolonged duration, which allow for a sustained relationship with the surrounding environment. Observation is not treated as a neutral act, but as an engaged practice shaped by subjectivity, the body, and lived experience. In this way, everyday life becomes a field of experimentation in which the minimal or marginal acquires political and poetic significance.

Both artists also share an archival logic based on attention and contemplation. Their practices blur the boundaries between art, research, fiction, and ordinary life, proposing the gaze itself as a method for generating knowledge.

Keywords: gaze; contemporary art; drifting; archive.

Introduction

This research proposes a transversal reading of the practices of Agnès Varda and Sophie Calle through their shared artistic methodologies, understanding observation as a common method and a central axis for the production of knowledge in contemporary art. Rather than analyzing specific works, the focus lies on the procedures both artists develop: looking, moving, following, waiting, collecting and archiving as forms of research.

Point of departure

This research focuses on the practices of Agnès Varda (1928–2019) and Sophie Calle (b. 1953), two key figures in contemporary European art whose work revolves around drifting, observation, and the archive.

Agnès Varda—film director, photographer, and visual artist—was one of the most influential figures in modern cinema and a member of the founding circle of the French Nouvelle Vague. Throughout a filmmaking career

spanning more than sixty years, she developed a distinctive visual language that challenged conventional modes of representation and proposed new ways of seeing through film and image. Her work raises not only cinematic but also theoretical questions concerning the relationship between image, experience, and time. By moving fluidly between fiction, documentary, and contemporary art, Varda created a body of work marked by personal and experimental narratives, while using cinema as a social and political tool.

Sophie Calle, by contrast, is a conceptual artist whose practice combines photography, text, and installation in hybrid forms that explore everyday life and the boundaries between public and private space, identity, and storytelling. Observation functions in her work as a method of inquiry. A significant aspect of her practice is its autobiographical dimension: many of her projects originate in real situations that she herself initiates. These works often consist of documenting actions, encounters, or personal investigations. Because her work operates within such a deeply autobiographical—and in many ways ephemeral—terrain, shaped by the circumstances in which events unfold, chance inevitably becomes an active element within her creative process.

In both artists' practices, the act of looking operates as a central methodology, unfolding through drifting, displacement, and sustained attention to the everyday. Walking, observing, waiting, and recording become artistic research strategies that challenge and blur the boundaries between art and research, fiction and reality.

Observation as methodology

Within the framework of this research, observation is not understood as a merely perceptual or contemplative act, but as an active practice of knowledge production. To observe implies a sustained form of attention that engages the body, time, and lived experience, situating the subject in direct relation to the world. As Maurice Merleau-Ponty writes in *El ojo y el espíritu* (2013, 21): seeing is inseparable from the way we inhabit and translate what appears before us: we only truly see what we look at.

The act that enables observation is *the act of looking*, and looking allows images to circulate—from advertising billboards to painting—each emerging from particular points of view. As Peter Szendy argues in *Le supermarché du visible* (2017, 25): the ways in which we feel, perceive, see, and hear are shaped by underlying social and economic relations. Likewise, John Berger's central premise in *Modos de ver* (1972, 12) is *that looking is never neutral*. Questions such as *What do I see? Whom do I see? From where does my gaze emerge?* become crucial, particularly in recent decades, when attention itself has become one of the most contested resources of contemporary culture. The city perhaps offers the clearest stage for this dynamic: advertising screens, luminous notifications, and an uninterrupted flow of images colonize urban space, transforming how we look, observe, contemplate, and relate to our surroundings. To immerse oneself in the city with full bodily and mental

presence has become an unusual, almost anachronistic gesture. Jean Baudrillard, in *Cultura y simulacro* (1978, 34), describes this condition by suggesting that we live within a regime of signs that refer to nothing beyond themselves—a spectacle that replaces reality with its own endless reproduction.

For this reason, the act of looking—and therefore observation—constitutes an active practice of knowledge production, shaped by the position of the observer. As Chantal Maillard writes in *La baba de caracol* (2014, 38), attention is a practice that transforms both the observer and what is observed, implying an ethical disposition toward the real. The creative process, and with it the emergence of an artwork, demands a radical presence: a way of perceiving the environment as pure event. It requires an attentive and vulnerable openness—a readiness of the eye that sees, the ear that listens, and the body that senses without projecting what is already known. As Maillard further suggests (2014, 92), this involves becoming aware of what occurs in the instant before interpretation takes place, and later inviting the viewer to share that initial impression. Perceiving a drop of water falling is not the same as thinking about how it falls. Symbolic thought, often driven by the ego, pushes us to decode and produce complex interpretations that make us feel more intelligent and less vulnerable. Yet in doing so we risk losing what is essential: the event itself, the falling drop. If we believe that what we see conceals a mystery beyond its simple occurrence, we will discover nothing new; we will mistake the event for a projection of our expectations. The mystery does not lie beyond the instant but within it—the drop falling, simply, in its irreducible happening. This is the place where creation emerges and where the possibility of contemplation may reopen.

From this perspective, a different kind of gaze becomes possible: another way of inhabiting the present, opening new landscapes and horizons. For Merleau-Ponty, perception is fundamentally a mode of *being-in-the-world*, where knowledge arises from embodied experience rather than from a distant or supposedly objective viewpoint.

In this sense, observation cannot be understood as a passive activity or as a simple recording of what is visible, but as a situated practice that generates knowledge through the relationship between subject and environment. Observation entails a form of attention that resists the dispersive logic of contemporary image regimes and reactivates a sensory experience of the world. In looking, the subject does not merely recognize what stands before them; they establish relations, select, interpret, and generate meaning. Observation thus becomes a gesture that articulates perception, experience, and thought, where knowledge emerges not from objective distance but from direct engagement with what unfolds.

Within this research, observation is therefore approached as an artistic methodology capable of activating situated, sensitive, and open forms of knowledge, where looking also means inhabiting, attending to, and thinking the world through lived experience. In this regard, Andrea Soto Calderón writes in *Imaginación material* (2022, 45) that “it is urgent to cultivate images capable of fissuring the belief—constructed through the systematic erasure

carried out by dominant cultures—that there are no other valid ways of doing, no other modes of critical existence, no other forms of life. They do exist, but they have been suffocated almost to the point of disappearance; the challenge lies in how to organize these latent possibilities so that they may activate their movement.” In a similar vein, Gilles Deleuze and Félix Guattari argue in *¿Qué es la filosofía?* (1993, 108) that “thinking is not recognizing, but producing”. This perspective allows observation to be understood not as a passive act of recognition but as an ongoing process in which meaning emerges through experience itself. Observation thus becomes an artistic practice that does not simply aim to represent reality, but rather to establish relations, generate thought, and activate sensitive forms of knowledge—situating the act of looking as a space from which other ways of perceiving, thinking, and inhabiting the world may emerge.

The wandering gaze

The *act of looking* involves multiple dimensions, among them the presence of the other’s gaze. Both Agnès Varda and Sophie Calle construct narratives in their work through encounters with others, where observation becomes a way of approaching and understanding the world. The gaze they propose is not unilateral but reciprocal: on the one hand, they observe those who cross their paths; on the other, those same individuals return the gaze, addressing and challenging the observer. In this sense, Georges Didi-Huberman argues in *Lo que vemos, lo que nos mira* (2014, 15) that “the gaze is only possible as a double operation,” suggesting that every visual experience also involves being affected by what we look at. From this perspective, observation can no longer be understood as a distant or neutral gesture, but rather as a relationship. In both Varda’s and Calle’s work, looking entails entering into contact with others and accepting the possibility of being affected by their presence, their gestures, or the ways in which they respond to that gaze. However, while Varda often builds relationships of proximity and attentive listening with the people she films, Calle’s observation moves into a more ambiguous territory, where curiosity, surveillance, and distance generate different tensions in her relationship with the other. In both cases, observation goes beyond the mere recording of the visible and opens a space of encounter in which the gaze becomes relational and transformative. This raises further questions: how does observation change when it becomes an encounter? What happens when the person being observed responds to the gaze? At that moment, observation ceases to be a unilateral gesture and becomes a relationship that transforms both the observer and the observed. The gaze no longer simply records what is visible; it opens itself to being affected by what appears. In this sense, attention also implies a form of availability toward the other. As Chantal Maillard suggests, to attend is to suspend one’s own certainties, allowing what is observed to manifest itself and potentially shift the observer’s perception. Observation thus becomes an experience in which the subject does not fully control what occurs but instead exposes themselves to a relationship capable of altering how they see.

In *Daguerréotypes* (1976), Agnès Varda constructs a portrait of everyday life on Rue Daguerre through direct encounters with her neighbors. The camera does not simply describe their activities; it creates a space for storytelling in which each person returns the gaze through memory, speech, and presence. Through conversations and small everyday gestures, the film establishes a mode of observation grounded in proximity and attentive listening, where the camera functions less as an instrument of recording than as a device that enables encounter. In this way, the gaze becomes a shared space in which individual stories emerge and intertwine, forming a collective memory of the place.

This dynamic is also connected to the extent to which the artist allows themselves to be affected during the creative process. As Chantal Maillard writes in *La baba de caracol* (2014, 77), the process involves becoming aware—through a rupture with ordinary discourse—of the nature of one's own mind: its emptiness and instability. From this perspective, observation implies an openness that allows what appears to transform the observer. In Varda's films, the image is built precisely through a convergence of gazes: encounters between the filmmaker and those she films, but also between the spectator and what appears on screen. Varda gives a privileged place to those she looks at and to those who return her gaze, positioning at the center of the image subjects who are not merely observed but actively participate in the construction of the narrative. Through these encounters, her cinema proposes a form of knowledge that arises from relationships with others, where the gaze becomes both a position and a way of grasping the world, while the filmmaker simultaneously recognizes herself in relation to those she films. In this process, a dimension of intimacy and subjectivity emerges, as the director allows herself to be affected by what unfolds. If we are able to see and hear, it is because there are stories, gestures, and presences that deserve attention. In this way, Varda does not merely show; she questions and values certain experiences through inquiries that often continue beyond the film itself. It is within the spectator's mind that these questions persist, creating a kind of montage between the visual and the sonic layers where the meanings proposed by the director continue to unfold.

By contrast, in *L'Hôtel* (1981), Sophie Calle observes from absence: the bodies are not present, only their objects, traces, and belongings remain. Through the archive of these remnants and the texts that accompany them, the artist constructs a form of knowledge based on intimacy without direct dialogue. Observation no longer emerges from encounter, as it does in Varda's cinema, but from a silent proximity to what remains when the other is no longer there. The hotel rooms become spaces where human presence appears only through minimal traces—forgotten clothes, suitcases, letters, or the arrangement of objects—that allow the viewer to imagine the lives of those who once occupied them.

Within this context, observation takes on an almost detective-like dimension: the artist gathers fragments, interprets signs, and constructs possible narratives from scattered clues. Yet this gaze does not attempt to reveal a definitive truth about those who inhabited the rooms; rather, it highlights how intimacy can be reconstructed through what persists in someone's absence.

In this way, Calle moves observation into an ambiguous territory between curiosity, investigation, and fiction, where looking also means confronting the boundaries between public and private. The absence of a direct interlocutor transforms observation into an act of interpretation, where knowledge emerges from the relationship between material traces and the imagination of the observer.

Being affected takes on a particular form here. Although the connection to observation remains, the intimacy that Sophie Calle seeks is constructed differently. In several of her works, the artist shifts her own position as a subject in order to approach the lives of others, temporarily suspending her everyday routines, decisions, and even her own objectives in relation to the strangers she observes or follows, her decisions and even her own aims are momentarily displaced into the figure of the stranger she observes or follows. This gesture entails a suspension of her own identity, allowing her to position herself at the threshold between the public and the private, exploring the tensions that emerge within this intermediate space. Calle does not fully reveal the intimacy of the other; rather, she reconstructs it through fragments, silences, and traces. As Byung-Chul Han notes in *La sociedad de la transparencia* (2013, 34), contemporary culture tends to dissolve the distance between the public and the private in favor of an increasing exposure of intimate life. In contrast to this logic of total visibility, Calle's practice preserves the distance necessary to reconstruct intimacy without subjecting it to complete disclosure.

Unlike the cinema of Agnès Varda, where observation unfolds through encounter and dialogue, Calle's practice introduces a more unsettling and ambiguous dimension. Her gaze does not merely seek to understand the other, but rather to inhabit their trace momentarily, creating situations in which curiosity, proximity, and intrusion call into question the very limits of observation. While in Varda knowledge emerges from encounter, in Calle it arises from distance and absence. Yet in both cases observation functions as a relational methodology that produces meaning not through definitive answers, but through the experience of the encounter itself—or its absence—transforming the creative act into a space where, rather than formulating questions, possible responses begin to take shape.

In this sense, the practice of Sophie Calle suggests that intimacy is not a territory that can simply be revealed, but rather a space that must be constructed and reconstructed through attention, distance, and sensitivity toward the other. Her work demonstrates how observation can operate both as an act of presence and as one of withdrawal—an exercise that maintains the tension between the visible and the hidden, inviting us to reconsider the boundaries between private and public life, between curiosity and intrusion, and ultimately between knowing and inhabiting another person's life. Taken together, the practices of Agnès Varda and Sophie Calle reveal that artistic observation cannot be reduced to the immediate documentation or comprehension of the other. While Varda constructs intimacy through encounter and dialogue, establishing a direct relationship with her subjects, Calle approaches it from a distance, inhabiting fragments and traces that reveal only partial glimpses of other lives. Despite these differences, both practices share the same relational logic: meaning emerges from the

experience of observing, participating, or even withdrawing, rather than from definitive conclusions. In this way, the work of Varda and Calle reminds us that observation—whether close or distant, dialogical or silent—transforms curiosity into a tool for understanding, and the encounter with the other into a space for reflecting on the limits of intimacy and public life. In both practices, to observe is not to look from the outside, but to establish a relationship that transforms both the observer and what is observed. As Andrea Soto Calderón paraphrases Gilles Deleuze in *Imaginación material* (2022, 11): the creator, says Deleuze, bends language, makes it vibrate, embraces it and fractures it in order to wrest perception from perceptions, affect from affections, sensation from opinion—creating for a people that does not yet exist.

Discussion

The practices of Agnès Varda and Sophie Calle position observation as a profoundly political act, revealing that every gaze entails taking a stance. In their work, observing is not merely about recording what is visible; it involves engaging in a relationship with the world that is shaped through encounter, attention, and experience. Both artists explore less conventional paths, where chance, wandering, intuition, boredom, or idleness acquire methodological significance within the creative process. In this sense, drifting—aimless walking and openness to the unexpected—becomes a way of approaching the environment that allows attention to what usually remains at the margins of visibility.

At the same time, their practices challenge the regimes of visibility that determine which bodies, voices, and experiences are deemed worthy of being seen, narrated, or preserved. Through encounters, traces, and fragments of everyday life, both Varda and Calle construct ways of seeing that do not aim to transparently represent reality but to intervene in it, disrupting the hierarchies that govern who may speak, who is heard, and who remains silent. Observation thus becomes a process that links experience, memory, and the collection of traces, where gathering fragments and organizing materials gives rise to archival forms that do not seek to fix meaning once and for all, but to keep open the relationships between images, narratives, and experiences.

In a context marked by image saturation and the acceleration of visual consumption, these practices assert attention as a form of resistance to dominant rhythms of production and consumption. To look entails pausing, lingering, and allowing oneself to be affected by what appears. From this perspective, observation ceases to be a passive gesture and becomes a critical tool capable of activating other forms of sensitive, situated knowledge, compelling us to ask not only what we see but also who is looking, from where, and with what consequences.

Conclusions

This research argues that artistic observation should be understood as a relational and critical methodology rather than as a neutral act of visual registration. First, the works of Agnès Varda demonstrate that observation can generate knowledge through proximity, encounter, and dialogue, where attentive engagement with everyday life allows overlooked voices and experiences to emerge. Second, the practice of Sophie Calle reveals an alternative mode of observation based on distance and absence, in which intimacy is reconstructed through fragments, traces, and material remains rather than direct interaction. Third, both artistic approaches show that observation operates through processes such as wandering, attention, and the collection of materials, transforming lived experience into narrative structures and archival forms. Taken together, these practices suggest that observation in contemporary art is not simply a means of representing reality, but a methodological tool that produces meaning through relationships, positionality, and the organization of experience.

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Author Contribution

Author: Conceptualization, investigation, writing, original draft.

Tools of Artificial Intelligence

The author used AI-powered tools to translate certain passages into English, as Spanish is his native language. These tools (ChatGPT and DeepL) were also used to conduct preliminary searches of the academic literature, although all cited sources were subsequently checked and verified directly.

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Strategies to Reduce Gender Bias and Encourage Female Participation in engineering workforce in Pakistan

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Abstract: Pakistan faces a severe gender disparity, ranking 148th globally in the 2025 World Economic Forum Global Gender Gap Report. Despite women comprising half the population, only 33,000 are licensed engineers with the Pakistan Engineering Council, and approximately 70% of female engineering graduates remain unemployed or underutilized. This study aims to identify strategies to reduce gender bias and increase female participation across Pakistan's engineering sector. A mixed methods approach was adopted, combining qualitative interviews with female engineers and industry stakeholders, and quantitative surveys of graduates and employers, while examining workplace culture, institutional frameworks, and regulatory barriers. Findings highlight structural, cultural, and professional obstacles, with field-based roles remaining largely male dominated. Pakneftegaz, through mentorship and professional development initiatives, serves as a model for supporting women engineers. Implementing inclusive policies, strengthening institutional support, and promoting professional growth are essential to narrowing gender gap and fostering innovation and sustainable development in Pakistan's engineering workforce.

Keywords: Gender disparity; women engineers; Pakistan Engineering Council; workplace barriers; female participation.

Introduction

Gender disparity remains a significant challenge in Pakistan's engineering workforce, limiting the country's potential for innovation and sustainable development. According to the 2025 World Economic Forum Global Gender Gap Report, Pakistan ranks last globally, positioned 148th out of 148 countries (World Economic Forum, 2025), reflecting one of the lowest levels of gender parity worldwide. Despite women constituting roughly half of the national population (UN Women, 2020), only 33,000 women are registered engineers under the Pakistan Engineering Council, representing a small fraction of the national engineering workforce. This underrepresentation is further reflected in employment patterns: approximately 70% of female engineering graduates remain unemployed or outside the labor force, while the remaining 30% are employed primarily in office based or academic roles, often in positions that offer limited decision-making authority or career advancement opportunities.

Technical and field-based roles, including maintenance, welding, plant commissioning, inspection, civil works, and surveying, remain largely male dominated, restricting women's opportunities to engage in critical sectors of engineering practice.

From a scientific perspective, gender disparities in engineering can be understood through labor market theories, organizational behavior frameworks, and social role theory, which explain how societal expectations, structural barriers, and individual agency intersect to limit female participation in technical fields (Eagly & Wood, 2012; Heilman, 2012). Previous research highlights that gender diversity is not only a social imperative but also a measurable determinant of innovation outcomes, productivity, and organizational performance (Hunt et al., 2018). By situating the present study within this scientific context, the research integrates empirical evidence on workforce dynamics with a theoretical understanding of gendered barriers in technical professions.

The reasons for this gender disparity are complex, involving social, cultural, institutional, and structural barriers. Societal norms often discourage women from pursuing engineering careers or working in field-based roles, while professional environments may be unsupportive due to a lack of inclusive policies, mentorship, and professional networks. Sexual harassment, discrimination, and limited workplace flexibility further exacerbate the challenges for women engineers, reducing both recruitment and retention rates. In addition, women rarely register under contractor categories, restricting their access to senior technical roles and leadership positions, and perpetuating a cycle of gender inequality within engineering organizations.

Addressing this disparity is critical not only for social equity but also for the economic and technological advancement of Pakistan. Studies indicate that gender diversity in technical fields enhances innovation, productivity, and problem-solving capabilities. Empirical studies suggest that organizations with higher gender diversity report 20–30% greater innovation revenue and improved problem-solving efficiency (Catalyst, 2020), supporting the hypothesis that increasing female representation has measurable economic and technological benefits. By encouraging women to participate fully in engineering, Pakistan can expand its talent pool, increase creativity, and promote sustainable development across sectors such as infrastructure, energy, and technology. Moreover, increasing female participation in engineering can serve as a catalyst for broader societal change, challenging entrenched gender norms and promoting inclusive growth.

Prominent female engineers in Pakistan have demonstrated the potential of women to excel in technical fields. Dr. Sarah Qureshi, who earned her PhD in Aerospace Propulsion Engineering from Cranfield University, United Kingdom, has contributed to advanced research in aeronautics and propulsion systems. Similarly, Dr. Ramla Qureshi, an Assistant Professor of Civil Engineering at McMaster University, Canada, has established herself as a thought leader in structural engineering, highlighting the global relevance and impact of Pakistani female engineers. Yasmeen Lari, Pakistan's first female architect, educated at the School of Architecture, Oxford Brookes

University, has not only pioneered architectural design in Pakistan but also championed social and sustainable construction initiatives. These examples provide scientific evidence that women can contribute to both knowledge creation and practical innovations in engineering and architecture, supporting the theoretical premise that reducing gender bias can enhance sectoral efficiency and innovation.

Organizations like Pakneftegaz are playing a crucial role in bridging the gender gap in Pakistan's engineering workforce. Pakistan based organization Pakneftegaz, a research and training oriented organization, implements mentorship programs, professional development workshops, and workplace inclusivity initiatives designed to empower women engineers and technicians. These interventions can be analyzed using organizational science models that emphasize the role of institutional support in overcoming systemic barriers, demonstrating how structured programs contribute to measurable improvements in female participation and skill development. By providing targeted support, Pakneftegaz addresses structural barriers that prevent women from advancing in technical and leadership roles, promoting both skill development and professional networks. Their initiatives serve as an example of how institutional support can complement policy reforms and societal efforts to increase female participation in engineering.

The aim of this research is to identify effective strategies to reduce gender bias and enhance female participation in Pakistan's engineering sector. Specifically, this study examines the structural, cultural, and professional barriers that limit women's engagement, explores sectors with untapped female potential, and proposes actionable interventions to create inclusive and supportive work environments. By situating these objectives within the broader scientific discourse on gender equity, organizational behavior, and labor economics, the study provides a theoretically informed and empirically grounded framework for addressing gender disparities. By analyzing both qualitative and quantitative data, the research seeks to provide a comprehensive understanding of the challenges and opportunities for women engineers, contributing to informed policy decisions and organizational practices.

In summary, the gender gap in Pakistan's engineering workforce is a multi-faceted issue influenced by societal norms, institutional barriers, and professional practices. While female engineers have demonstrated exceptional capabilities and leadership potential, systemic challenges continue to hinder their full participation, particularly in technical and field-based roles. Integrating the study's findings with established scientific frameworks underscores the broader relevance of the research, showing how empirical evidence on Pakistan's context can inform global debates on gender equity in engineering fields. Addressing these challenges requires a combination of policy reforms, institutional support, mentorship programs, and societal awareness. By promoting female participation and reducing gender bias, Pakistan can unlock the full potential of its engineering talent, enhance innovation, and foster sustainable development. Organizations such as Pakneftegaz exemplify the positive impact of targeted interventions,

demonstrating that strategic support can significantly enhance women's engagement and leadership in engineering.

Methodology

This study adopts a mixed methods research design, combining qualitative and quantitative approaches to explore the barriers, perceptions, and strategies related to female participation in Pakistan's engineering workforce. A mixed methods approach is particularly suitable for this research as it provides both depth and breadth, allowing for an in-depth understanding of individual experiences through interviews while also providing statistically relevant data through surveys. By integrating these methods, the study aims to capture the complexity of gender disparities in engineering and identify actionable strategies to promote inclusivity and professional advancement for women.

Research Approach

The qualitative component of the research involved semi structured interviews with female engineers, employers, and industry stakeholders. The interviews were designed to elicit detailed narratives regarding challenges in the workplace, experiences of discrimination or bias, and perceptions of institutional support. Interview participants were selected from a range of engineering sectors, including civil, mechanical, electrical, software engineering and other engineering fields, to ensure diversity of perspectives. Specific attention was given to women in field-based roles such as plant commissioning, civil works, maintenance, and inspection, as these positions remain largely male dominated in Pakistan.

The quantitative component comprised structured surveys administered to female engineering graduates and employers. Survey questions focused on employment status, workplace environment, access to professional networks, mentorship opportunities, and organizational policies regarding gender inclusivity. Likert scale responses, multiple choice questions, and demographic data were collected to analyze trends in female participation and identify systemic barriers. The survey was distributed electronically and in-person at Pakistani engineering universities, professional organizations, and workplaces, ensuring representation across urban and semi-urban areas.

Sampling and Participant Selection

A purposive sampling strategy was employed for both qualitative and quantitative data collection. Female engineers with varying levels of experience, including recent graduates and senior professionals, were included to capture a comprehensive range of experiences. Employers and industry stakeholders were selected based on their engagement with engineering projects and workforce management responsibilities. The sample also included representatives from Pakneftegaz, a research and training oriented organization addressing the engineering gender gap in Pakistan. Pakneftegaz provided insights into mentorship programs,

professional development initiatives, and workplace inclusivity practices, serving as a critical case study for the research.

In total, the study conducted 35 qualitative interviews and 350 survey responses. Participants were informed about the study's objectives and provided consent, with assurances of confidentiality and the option to withdraw at any time. Ethical considerations were prioritized, particularly given the sensitivity surrounding workplace harassment and gender discrimination.

Data Collection Procedures

Qualitative data were collected using semi structured interview guides, allowing participants to share detailed experiences while providing the flexibility to explore emerging themes. Interviews were conducted in Urdu, lasting between 45 and 90 minutes.

Quantitative data were gathered through structured surveys, which included both closed and open-ended questions. Surveys captured information on employment status, sector representation, career progression, mentorship access, professional networking opportunities, and experiences of gender bias. Participants demographic information, including age, education, and years of experience, was also recorded to identify patterns in workforce participation.

Data Analysis

Qualitative data analysis followed a thematic approach, identifying recurrent patterns and categorizing them into major themes. Themes included structural barriers, cultural norms, workplace harassment, lack of mentorship, limited leadership opportunities, and sector specific challenges. Special attention was given to insights from Pakneftegaz, highlighting successful interventions that could serve as replicable models across other organizations.

Quantitative data analysis employed descriptive statistics, cross tabulations, and frequency analysis. Employment rates, sector distribution, and access to professional networks were quantified, while correlations between demographic factors and workplace experiences were examined. Key statistics regarding female engineers' workforce participation are presented below in both numbers and percentages in Table 1.

Role of Pakneftegaz

Pakneftegaz served as both a data source and a model organization in this research. The organization's mentorship programs, professional development initiatives, and efforts to foster workplace inclusivity provided practical examples of how systemic interventions can increase female participation in engineering. Interviews with Pakneftegaz affiliated researchers and participants offered insights into program effectiveness, challenges faced, and potential strategies for replication in other organizations. Their approach illustrated the importance of institutional commitment, targeted training, and network building in reducing gender bias and supporting women engineers.

Table 1. Workforce Participation and Professional Engagement of Female Engineers in Pakistan

Indicator	Number of Women	Percentage
Total female engineers registered under Pakistan Engineering Council	33,000	100%
Female engineering graduates unemployed	23,100	70%
Female engineers employed	9,900	30%
Sector distribution of employed female engineers	Civil: 2,475 Mechanical: 1,980 Electrical: 1,485 Software: 2,475 Other: 1,485	Civil: 25% Mechanical: 20% Electrical: 15% Software: 25% Other: 15%
Female engineers with access to professional networks	3,960	40%
Female engineers participating in mentorship programs	3,465	35%
Female engineers reporting limited career progression due to gender bias	5,940	60%

Results

The results of this study highlight the multifaceted challenges and opportunities associated with female participation in Pakistan's engineering workforce. By combining qualitative interviews and quantitative survey data, this research identifies patterns of underrepresentation, sector specific trends, and effective interventions to reduce gender bias. The findings are organized into three main areas: workforce participation and sector distribution, structural and cultural barriers, and the impact of targeted interventions, including those implemented by Pakneftegaz.

Workforce Participation and Sector Distribution

Survey data revealed that the majority of female engineering graduates in Pakistan remain underemployed or outside the formal labor force. Approximately 70% of surveyed female engineers reported either unemployment or engagement in non-engineering roles, while only 30% were employed in engineering related positions. Among the employed respondents, office based, academic, or administrative roles dominated, with only a small fraction occupying field-based positions such as civil works, plant commissioning, maintenance, and inspection.

Sectoral analysis indicated that civil and electrical engineering fields had the highest representation of employed female engineers, largely in office or design roles. In contrast, mechanical, petroleum, and construction sectors exhibited minimal female participation in operational roles, reflecting entrenched gender norms and workplace practices. Notably, sectors

requiring physical labor or fieldwork, such as plant maintenance, surveying, and welding, were overwhelmingly male-dominated.

Structural and Cultural Barriers

Qualitative interviews highlighted the persistence of structural and cultural barriers that inhibit female participation. Many participants reported experiences of workplace harassment, limited mentorship opportunities, and exclusion from professional networks. One recurring theme was the lack of access to contractor or project management categories, which restricts women's advancement into leadership positions. Female engineers indicated that even when qualified, they are often overlooked for promotions or challenging assignments, perpetuating gender bias and limiting professional growth.

Cultural expectations also emerged as a significant barrier. Respondents noted that societal norms discourage women from pursuing field-based engineering roles, with families often prioritizing safety and traditional gender roles over professional ambitions. These expectations contribute to a preference for office-based positions, further concentrating women in non-technical roles. Additionally, participants described the absence of workplace policies that accommodate gender-specific needs, such as flexible work schedules, maternity support, or anti-harassment mechanisms.

Pakneftegaz Interventions and Impact

Pakneftegaz's initiatives demonstrated tangible benefits for female engineers. Through mentorship programs, technical workshops, and professional development sessions, the organization fosters skill development, confidence building, and network expansion. Interviewees who participated in Pakneftegaz programs reported improved access to challenging assignments and greater readiness to assume leadership roles. The organization's approach addresses both structural barriers (through formal training and access to projects) and cultural barriers (by promoting professional visibility and confidence among women).

Pakneftegaz's mentorship model also provides a replicable framework for other organizations seeking to enhance gender inclusivity. Mentors guide mentees through career planning, technical skill acquisition, and networking opportunities, resulting in improved employment outcomes. Survey responses indicated that participants involved with Pakneftegaz programs were twice as likely to report satisfaction with career progression compared to peers not involved in structured mentorship initiatives. These findings underscore the importance of institutional support in overcoming systemic challenges, demonstrating that targeted interventions can significantly influence female engineers' engagement and retention.

Emerging Themes from Qualitative Data

Analysis of qualitative interviews identified several recurring themes that inform potential strategies to reduce gender bias:

- (i) Lack of Mentorship and Role Models: Participants emphasized the importance of guidance from experienced female engineers to navigate workplace challenges.
- (ii) Exclusion from Decision Making Roles: Women reported limited involvement in project planning, commissioning, and operational decision making.
- (iii) Workplace Harassment and Safety Concerns: Experiences of harassment and lack of field safety measures deter women from pursuing technical roles.
- (iv) Societal Expectations and Cultural Norms: Traditional gender roles influence career choices and limit mobility, particularly in rural or conservative regions.
- (v) Institutional Gaps: Absence of inclusive policies, insufficient recruitment strategies, and inadequate recognition of women's contributions exacerbate gender inequity.

These qualitative insights complement the survey data, highlighting the interplay between structural, cultural, and professional barriers.

Identification of High Potential Sectors

The study also mapped sectors with untapped potential for female engineers. Civil engineering projects involving design, planning, and supervision present significant opportunities for women, particularly when combined with institutional support and mentorship. Renewable energy and software engineering emerged as fields with growing demand for female talent, reflecting global trends in STEM diversification. The analysis suggests that with targeted interventions, including skills training and inclusive workplace policies, female engineers can successfully participate in technical and field-based roles previously dominated by men.

In conclusion, the results illustrate the persistent underrepresentation of women in Pakistan's engineering workforce, driven by structural, cultural, and institutional barriers. The research highlights the positive impact of mentorship programs, exemplified by Pakneftgaz, and identifies sectors where female participation can be expanded. These findings provide a foundation for actionable strategies aimed at reducing gender bias, fostering inclusivity, and promoting professional growth for women engineers in Pakistan.

Strategies to Reduce Gender Bias

Reducing gender bias and increasing female participation in Pakistan's engineering workforce requires a multi-faceted approach involving policy reforms, institutional interventions, cultural shifts, and educational initiatives. The findings of this study, coupled with insights from prominent role models and the success of organizations such as Pakneftgaz, highlight actionable

strategies that can address structural, professional, and societal barriers limiting women in engineering.

Policy Recommendations

Effective policy interventions are essential to creating a more inclusive engineering workforce. Organizations should implement gender sensitive recruitment policies, ensuring equal opportunities for women in hiring, promotions, and assignments. Specific attention should be given to integrating women into contractor and field-based roles, which are traditionally male dominated. This would not only enhance career progression but also increase the diversity of skills in technical teams.

Government of Pakistan and professional bodies, such as the Pakistan Engineering Council, can introduce mandatory gender inclusivity guidelines for companies employing women engineers. These policies may include quotas for female representation in technical and leadership positions, regular monitoring of gender equity in employment statistics, and compliance audits. Additionally, flexible working hours, maternity leave, and childcare support can reduce the attrition of women engineers and encourage long term engagement in the workforce.

Institutional Interventions

Institutions and organizations play a crucial role in providing support and resources for female engineers. Mentorship programs are a particularly effective intervention, as demonstrated by Pakneftegaz. Structured mentorship allows experienced professionals to guide women in skill development, networking, and career planning. Mentors can also help mentees navigate workplace challenges, such as bias or harassment, by providing advice and advocacy.

Professional development workshops can equip women with technical competencies, leadership skills, and project management experience. Organizations should establish networking opportunities that allow women to connect with peers and senior engineers, fostering a sense of community and professional visibility. Leadership training programs can prepare women to assume managerial and decision-making roles, addressing the persistent underrepresentation in project planning and executive positions.

Additionally, institutions must implement anti-harassment policies and grievance mechanisms, ensuring a safe and supportive work environment. Awareness campaigns can reinforce ethical standards and hold supervisors accountable for promoting gender inclusivity. Organizations that actively cultivate an inclusive culture tend to experience higher retention rates of women engineers, demonstrating the importance of systemic institutional commitment.

Cultural and Societal Changes

Cultural norms and societal expectations significantly influence female participation in engineering. Campaigns to raise awareness about the

capabilities and contributions of women engineers can challenge stereotypes that associate technical and field-based work exclusively with men. Prominent female role models, such as Dr. Sarah Qureshi, Dr. Ramla Qureshi, and Yasmeen Lari, can serve as examples to inspire aspiring engineers and shift societal perceptions regarding women in engineering fields.

Family and community engagement is also essential. Encouraging families to support women pursuing engineering careers, particularly in field-based roles, can reduce resistance and foster confidence. Media representation of women engineers in leadership, research, and technical roles can further normalize female participation and motivate younger generations to consider engineering as a viable career path.

Educational Initiatives

Education forms the foundation for long term gender inclusivity in engineering. Scholarships, internships, and research opportunities targeted specifically at women can increase enrollment and retention in engineering programs. Universities and technical institutes should incorporate gender diversity modules into engineering curricula, promoting awareness of equity, inclusivity, and leadership skills from the outset of professional training.

Partnerships between educational institutions and industry can provide hands on experience in technical and field-based roles, addressing the gap between academic preparation and practical application. Initiatives by organizations like Pakneftegaz, which link academic knowledge to professional training, are particularly effective in equipping women with the skills and confidence necessary to enter male-dominated sectors.

Integrated Strategy Framework

To maximize impact, strategies must be integrated across policy, institutional, societal, and educational domains. For example, gender sensitive hiring policies are most effective when paired with mentorship programs, professional development, and cultural awareness campaigns. Likewise, scholarships and fieldwork opportunities can be complemented by organizational support and safe workplace environments, ensuring that female engineers can sustain long term careers.

The study's findings indicate that targeted interventions lead to measurable improvements in participation, retention, and leadership opportunities. Survey respondents involved in structured mentorship programs or organizations with inclusive policies reported higher satisfaction, greater confidence, and increased engagement in technical projects. These results underscore the importance of a comprehensive, coordinated approach that addresses both external barriers and internal organizational practices.

Discussion

The results of this study reveal that female participation in Pakistan's engineering workforce is severely constrained by structural, cultural, and institutional barriers, echoing trends observed globally while reflecting unique national challenges. Quantitative findings show that approximately 70% of female engineering graduates remain unemployed or underutilized, with the majority of employed women concentrated in office based or academic roles. Field based, technical, and leadership positions remain overwhelmingly male dominated. Qualitative insights further illuminate the pervasive challenges, including limited mentorship, workplace harassment, exclusion from decision making roles, and societal norms that discourage women from pursuing engineering careers. From a scientific standpoint, these findings align with gender stratification theory and labor economics models, which predict that unequal access to resources, networks, and opportunities leads to measurable disparities in professional outcomes (Reskin & Roos, 1990). These findings highlight the need for comprehensive, context-sensitive strategies to promote gender inclusivity.

Comparison with Global Trends

Internationally, similar patterns of underrepresentation exist, particularly in sectors such as mechanical, electrical, and civil engineering, where hands on roles are traditionally male-dominated. UNESCO's 2025 report indicates that women comprise only 28% of the global engineering workforce, reflecting persistent barriers across cultural and geographic contexts. However, countries like Lithuania, which have implemented inclusive policies, mentorship programs, and targeted educational initiatives, show higher female participation in technical and leadership roles. In this respect, Pakistan's gender gap is significantly wider than in many comparable countries, suggesting that structural reforms, cultural interventions, and institutional support remain underdeveloped. These global comparisons provide a scientific benchmark for evaluating the efficacy of Pakistan's interventions, situating the study's results within an international evidence base.

The findings underscore the role of institutional interventions, particularly mentorship and professional development, in improving female engagement. The case of Pakneftegaz demonstrates that structured support programs can significantly enhance career progression, confidence, and professional networking. Participants in Pakneftegaz programs reported greater access to challenging assignments, higher satisfaction with career development, and a stronger sense of professional identity. Scientifically, these outcomes are consistent with human capital theory and social network theory, which posit that targeted skill development and professional connectivity directly improve labor market outcomes for underrepresented groups (Becker, 1993; Granovetter, 1973).

Cultural and Societal Context in Pakistan

While structural interventions are critical, societal and cultural norms remain a powerful determinant of female participation in engineering. Traditional gender roles and family expectations limit women's mobility and influence career choices, particularly for field-based engineering roles requiring travel or physical presence at industrial sites. Interviewees highlighted that social perceptions of engineering as a male dominated field, coupled with concerns for safety and reputation, contribute to the concentration of women in office-based or academic positions. Addressing these societal norms requires both awareness campaigns and visible female role models who challenge conventional narratives. Prominent Pakistani female engineers, including Dr. Sarah Qureshi, Dr. Ramla Qureshi, and Yasmeen Lari, exemplify the potential for women to succeed in technical and leadership roles, providing inspiration and legitimacy to efforts promoting gender equality in the field of engineering.

The research also indicates that cultural resistance can be mitigated when institutions actively support women engineers. Organizations that implement flexible working hours, maternity support, and inclusive recruitment strategies create environments where women feel empowered to participate in roles traditionally dominated by men. This interaction between culture and institutional support demonstrates empirically how social and organizational factors jointly influence female participation, a finding supported by organizational behavior literature emphasizing the importance of systemic interventions to alter entrenched gender norms (Ely et al., 2011).

Implications for Policy and Practice

The study's findings have significant implications for policy and organizational practice. At the national level, the Pakistan Engineering Council and government agencies can implement gender-sensitive policies mandating equitable representation in hiring, promotions, and contractor categories. Regular monitoring of employment statistics and compliance audits will ensure accountability and transparency. At the organizational level, mentorship programs, leadership training, anti-harassment policies, and professional networking opportunities are crucial to improving retention and career progression.

Education also plays a central role in fostering long term gender equity. Scholarships, internships, and integration of gender diversity modules in engineering curricula can prepare women with the skills, confidence, and professional networks needed to enter technical and field-based roles. Initiatives linking academia with industry, such as those led by Pakneftgaz, are particularly effective in bridging the gap between theoretical knowledge and practical experience. This aligns with research on STEM education and workforce development, which demonstrates that early and sustained interventions increase female representation in technical careers (Hill et al., 2010).

Limitations and Contextual Considerations

While the study provides valuable insights, several limitations must be acknowledged. The sample, though diverse, may not fully capture regional variations in female participation across Pakistan's provinces. Self-reported experiences of workplace harassment or bias may also be subject to underreporting, reflecting social sensitivities and fear of professional repercussions. Furthermore, while Pakneftegaz serves as a model for effective interventions, its strategies may require adaptation for implementation in other organizations with different resources, cultures, or operational structures.

Contribution to Knowledge and Practice

Despite these limitations, the study contributes substantially to understanding gender disparities in Pakistan's engineering workforce. By combining quantitative and qualitative data, it provides a holistic view of the barriers and opportunities for female engineers. The findings emphasize the importance of integrated strategies that combine policy reforms, institutional support, cultural awareness, and educational initiatives. By grounding these findings in scientific frameworks such as social role theory, human capital theory, and organizational behavior models, the research extends the knowledge base on how structural, cultural, and institutional factors interact to shape gendered professional outcomes. Importantly, the research highlights practical examples, such as Pakneftegaz, demonstrating that targeted programs can significantly enhance participation, skill development, and professional advancement.

International and Societal Relevance

The implications extend beyond Pakistan. Countries with similar gender disparities in engineering sector can learn from the study's insights, particularly regarding the effectiveness of mentorship programs, structured professional development, and the integration of gender equity modules in educational curricula. By addressing both structural and societal barriers, nations can create more inclusive engineering workforces, improve innovation, and foster sustainable development. In Pakistan, these measures are not only socially equitable but also economically strategic, unlocking the full potential of women engineers in driving national progress. Situating the study within the scientific discourse on workforce diversity and gender equity ensures that its findings contribute to both theoretical and practical advancements in the global engineering community.

Conclusions

Statement 1: Pakistan faces structural and cultural barriers that limit female participation in engineering. Argument: Structural barriers include limited access to contractor categories, technical roles, and inclusive workplace policies. Cultural norms and family expectations often steer women toward administrative or academic roles rather than field-based engineering work.

Addressing these barriers is essential to creating equitable opportunities and expanding Pakistan's engineering talent pool.

Statement 2: Effective strategies, including policy reforms, institutional support, and educational initiatives, can reduce gender bias. Argument: Policy-level interventions such as gender-sensitive hiring, quotas, and flexible work arrangements, combined with mentorship programs, professional development workshops, and gender diversity modules in curricula, collectively reduce disparities. An integrated approach across policy, institutional, cultural, and educational domains is most effective.

Statement 3: Organizations like Pakneftegaz play a pivotal role in supporting female engineers. Argument: Pakneftegaz provides mentorship, training, and networking opportunities that enhance skills, confidence, and career advancement. Structured institutional support complements broader policy and societal interventions, creating sustainable pathways for women engineers to thrive.

Statement 4: Reducing gender bias and increasing female participation fosters innovation, professional growth, and national development. Argument: Diverse engineering teams promote creative problem-solving, strengthen organizational performance, and contribute to infrastructure development, technological innovation, and economic growth. Inclusive workplaces inspire the next generation of female engineers and gradually shift societal norms.

Statement 5: Collective adoption of targeted strategies at multiple levels ensures measurable progress. Argument: Policy makers, organizations, educational institutions, and society must implement inclusive hiring, mentorship programs, scholarships, and recognition of female role models. Coordinated implementation of these strategies transforms Pakistan's engineering workforce into a more inclusive, equitable, and innovative sector, enabling female engineers to succeed and contribute to sustainable national development.

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Author Contribution

Author: Conceptualization of the study, research design and methodology, data collection and analysis, writing of all sections of the paper, review & editing, and final paper preparation.

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Pauline Oliveros and Deep Listening. Sound Art Strategies for an Ecofeminist Knowledge Construction

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Abstract: American composer and accordionist Pauline Oliveros developed two fundamental principles that became cornerstones of post-war sound experimentation. In her theories and musical experiences, she advocated a particular approach to mindfulness based on deep listening, a meditative practice that aspires to sonic awareness, promoting mindfulness of sound to motivate personal and social consciousness.

This study aims to promote an understanding of this type of attitude as a methodological framework for socio-cultural action and cooperative experimentation, incorporating a diversity of voices and attending to the specific characteristics of their situated realities. This sensitive approach is rooted in an intersectional and ecofeminist perspective that recognises the interdependence and eco-dependence of all beings as part of a reality characterised by indeterminacy.

Keywords: Deep Listening; sound art; ecofeminism; intersectionality; participation.

Introduction

Pauline Oliveros was an American accordionist, composer, and pioneer in experimental and electronic music. Born in Houston, USA, in 1932 she developed throughout her career two fundamental principles of sound experimentation that served as cornerstones for the electronic music created in the post-war period. Her career would be defined by a visionary compositional talent, technological innovation, and a humanitarian perspective, which continued until her death in 2016, emphasising the importance of listening and how this can influence and broaden the community. With a firm belief that, through their art, artists have a responsibility to bring people together, she built an incredible world-wide community during her life. In the artist's own words "I never tried to build a career, I only tried to build a community" (Weintraub, 2023). This ambition would inspire boundless creativity within her community in Kingston, New York, and amongst the world-class musicians with whom she regularly

collaborated. She had to overcome many obstacles placed in front of her by 1950's society, just for the fact of being a woman who identified as queer, which reinforces her commitment to listening and understanding.

The meditative practices based on Deep Listening, developed by Pauline Oliveros, set a precedent for contemporary sound creation (see Fig. 1). Considering its significant influence, this contribution aims to revisit this notion from an intersectional and ecofeminist perspective, focusing on certain current practices that are particularly attentive to specific social contexts and promote sound awareness as a tool for social transformation. Sound art experiences aligned with Deep Listening demonstrate the importance of listening as an epistemic, artistic, and relational practice. According to Oliveros, these participatory strategies dissolve the separation between subject and object or performer and audience, recovering remote forms that precede the roles of spectator.



Fig. 1. Deep Listening: The Story of Pauline Oliveros (Photo by Fred Lonidier included in the documentary film by Daniel Weintraub (2023): <https://thestoryofpaulineoliveros.com>)

Beyond developing a heightened state of self-awareness, Oliveros recognised how the sustained practice of these exercises would give her a profound sense of well-being (Oliveros, 2005, p. 25). Similarly, it was shown that relationships based on participation and exchange through sound could have a healing effect, as “individuals feel the common bond with others through a shared experience”; also because “one’s inner experience is made manifest and accepted by others”; and “when one is aware of and in tune with one’s surroundings”; and even “when one’s memories, or values, are integrated with the present and understood by others” (Oliveros, 1971). That demonstrated that by listening, it is possible to make a difference in the community, expand it and strengthen it. A commitment to listening and understanding can create an altered state of consciousness in which identification with other beings occurs naturally.

Deep Listening

In 1971 Pauline Oliveros wrote *Sonic Meditations*, a guide to practicing collective sound exploration that constitutes the foundation of Deep Listening. The various compositions included in this publication could be performed by people with no musical training. These experiences were focused on patterns of attention to heighten awareness of ways of listening and responding (Oliveros, 2005, p. 25). This set of exercises would promote an understanding and practice of philosophy, as well as the experience of attentive and creative listening within non-verbal meetings to develop positive energy, tuning the mind and body of the participants, even influencing others who were less experienced, as the author said in the introduction of the publication. The healing power of the sound energy became part of the group experience (see Fig. 2). The sonic exploration designed by Oliveros brings a peculiarly inclusive point of view, in that it pointed to any form of life, beyond the dichotomy between living and non-living beings.



Fig. 2. Pauline Oliveros. Deep Listening Study Circle. (The Center for Deep Listening: <https://www.deeplistening.rpi.edu/>)

Sound, as a physical phenomenon, makes us vibrate; it touches us. It brings to light the material-affective dimension of existence, as Karen Barad has said: “Touching oneself” is an encounter with the infinite otherness of the self (2023, p. 41). In this way, matter, being a fold, can do nothing but touch itself; and in touching itself, it comes into contact with the infinite otherness that it is. This allows us to “welcome the stranger” through the possibility of touching and being touched (Barad, 2023, p. 52), of listening and being listened to, in an exercise of mutual recognition and understanding of our responsibility towards the infinite diversity of the other. That way, Deep Listening is directly linked to the concept of coexistence and interdependence. And this interconnectivity implies a radical familiarity with other beings. According to Timothy Morton’s concept of the web, ecological thought recognises that all

things are interconnected and that “the boundaries between individuals, and their identities, are affected by this interconnectedness” (2018, p. 122).

Through her musical theories and experimental research, Oliveros advocated a particular approach to attention based on listening, with the aim of fostering *sonic awareness*: “She developed Deep Listening, a meditative practise that advocates mindfulness of sound to motivate personal and social consciousness, and founded the Deep Listening Institute, a nonprofit arts organization, in 1985” (Rodgers, 2010, p. 27). From the context of artistic creation and social studies, this research aims to recognize the value of deep listening as an inclusive epistemological model. It also seeks to examine the capacity of contemporary artistic practices based on listening to include the diversity of non-hegemonic voices, paying attention to and valuing the richness of diversity and the peculiarities of their situated realities.

Learning to listen as an artistic situated ecofeminist practice

Through an analysis of the theories developed by Oliveros herself, as well as a review of other works of sound creation and experimentation today, we propose an approach to Deep Listening as a methodological axis for sociocultural action. According to the theories of Situated Listening, deep listening strategies are a powerful tool for attending to the unheard (Loveless et al., 2025).

This strong conviction brings us back to models of inclusion and the celebration of diversity, such as that advocated by the Roma Project (López-Melero, Soler-García & Payá-Gómez, 2025). The need to listen to all voices, and not just those that stem from a position of privilege due to their proximity to the hegemonic norm, is something that bell hooks also championed throughout her Teaching Trilogy (2021, 2022 y 2024). hooks’ feminist thinking and social activism, rooted in the importance of love, emphasises the need for inclusive spaces that accommodate a diversity of voices—spaces where everyone can be listened to. Her vision focuses on the interconnectivity of race, class and gender in order to prevent the perpetuated conventional systems of domination and oppression. Listening to each unique voice allows us to incorporate the wisdom of personal experience into a process of collective knowledge-building. Listening creates space to learn from the gift that is the existence of other beings, involving a multifaceted perspective and addressing different realities within a fully inclusive process, listening and waiting together. As hooks states, even longing can constitute a form of knowledge (2021, p. 114).

This approach, developed by Oliveros, is rooted in the sensibilities of Eastern spiritual philosophy. As the artist explains, throughout the 1980s she studied different forms of meditation from various traditions: Zen, Tibetan Buddhism, yoga and Taoism (2005, p. 27). According to Oliveros herself, these practices deepened her understanding and appreciation of meditation, strengthening her work as a composer and performer.

In this study, we propose the practice of listening as an artistic, epistemological and ontological practice—a situated ecofeminist practice that promotes various contemporary sound-based artistic strategies through social engagement. As we have been pointing out, Oliveros’s holistic approach can be applied to social studies by incorporating a feminist, inclusive and intersectional perspective (hooks; López-Melero, Soler-García & Payá-Gómez, 2025; and Hill-Collins & Bilge, 2016). That way, Deep Listening can be understood as a methodological framework for the socio-cultural action of an autonomous yet ungovernable culture, as advocated by Jazmín Beirak (2022), capable of incorporating a diversity of voices while taking their specific contexts into account. It can therefore be argued that sonic exploration or sound meditation establishes a methodological framework for collaborative sound experimentation. These participatory strategies blur the subject/object or performer/audience distinction, reviving ancient forms that predate the roles typically associated with spectatorship (Oliveros, 1971). We can agree that “people are always listening, but what they are listening, to what they are giving attention to is the important thing” (Weintraub, 2023). Becoming aware, through listening, of what others think and say could help alleviate stress and violence. Knowing how to listen would foster greater acceptance and respect for those who are different.

Below, we will examine three examples influenced by the theories and practices of Deep Listening developed by Oliveros. We will also consider how these experiences approach listening as a collective and situated practice.

First, the work of sound artist and DJ Ain Bailey centres on the exploration of sound autobiographies and the acoustics of architectural contexts. In the project *Sonic Stories*, developed in 2019, Bailey invites a group of young women from Westminster Academy School in North London and approaches listening as a collective and situated practice, by questioning ideas like home, memory, identity, and place (Bailey, 2019). They recorded their own surroundings, transforming everyday objects into instruments, and creating shared soundscapes. Through collective listening and sound practices, they would be led to ask themselves what the distinctive sounds of their own space are; what *home* means; and what happens when we listen together. This analysis and reflection would lead them to consider how sounds can reinforce a sense of belonging to a particular space or context.

For an episode of Serpentine Podcast *On Practice* Bailey used *Ear Piece* by Pauline Oliveros. In this short exercise of Deep Listening, included in *Sonic Meditations* (1971), the public was asked to pay attention to the questions included at the infographic illustration created by Joy Yamusangie (see Fig. 3). On this occasion, the artist will be working in collaboration with Micro Rainbow, which supports LGBTQI+ asylum seekers and refugees who find themselves in isolation in the UK.

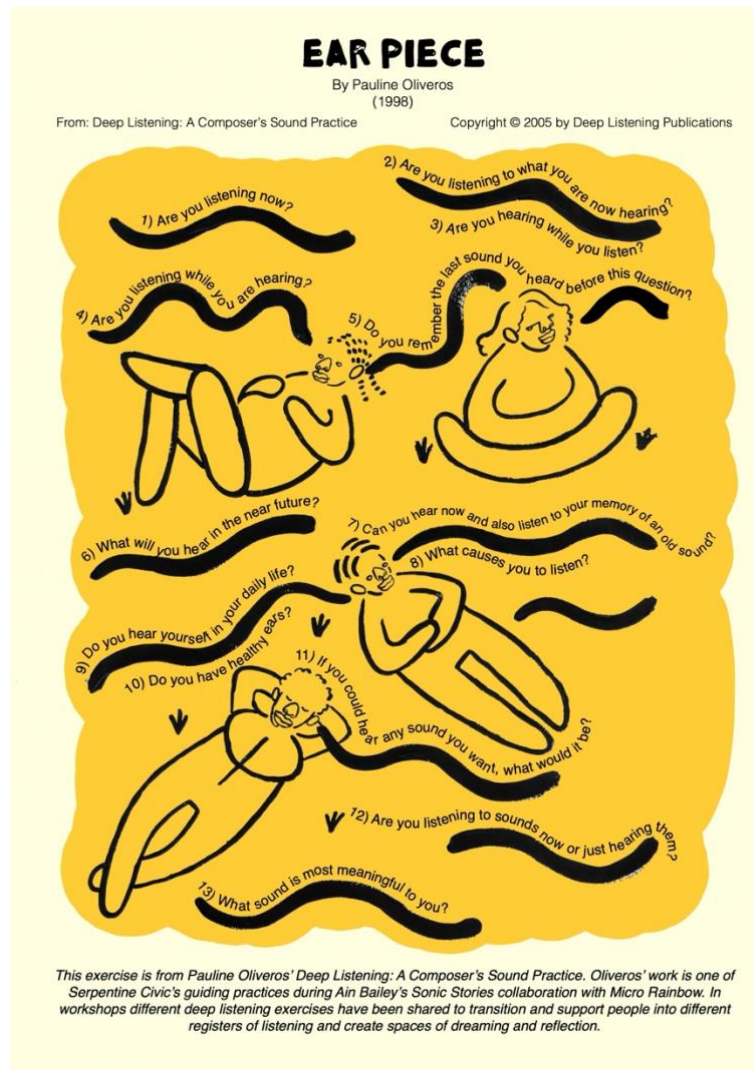


Fig. 3. Bailey, A. (2021). *Ear Piece*. Serpentine Podcast. (Design by Joy Yamusangie. Serpentine Gallery: <https://www.serpentinegalleries.org/art-and-ideas/on-practice-listening/>)

Throughout the workshops, various deep listening exercises would be shared with the aim of easing the transition and helping people to explore different modes of listening, creating open spaces for daydreaming and reflection. In the artist's own words: "There is the moment of free-ness in just being able to talk about it, their lives, without the trauma of like you know, their status, basically" (Bailey, 2021). By highlighting the difference between listening and hearing, this work emphasised how it is possible to create a space for political engagement through listening.

Un-Tuning Together: Practicing Listening with Pauline Oliveros was a collective exhibition curated by Maud Jacquin and Émilie Renard in Bétonsalon Center for Art and Research in Paris, 2023. The exhibition formed the second part of *Dissolving your Ear Plugs*, curated a few months earlier by Maud Jacquin together with Anne-Marie St-Jean Aubre at the Musée d'art de Joliette in Quebec, also in 2023. Rather than presenting a fixed tribute, the exhibition functioned as a shared space of experimentation. The participating

artists took Oliveros's concept of *Deep Listening* as both a conceptual and methodological framework, exploring the act of listening as a relational, ecological, and political practice. Drawing on Oliveros' concept of Deep Listening, this group exhibition explored the possibility of listening beyond the surface of the audible, delving into the hidden recesses of the acoustic environment. It opened up new forms of sensoriality through the various experiences presented and suggested a range of strategies for paying attention and ways of listening to ourselves, to others and to the collective environment, promoting attentiveness and receptiveness towards others and towards what is happening.

The various works that made up the exhibition expanded on Pauline Oliveros's ideas through a direct dialogue between the different research projects and the practice of Deep Listening: "Each artist [was] invited to inhabit the entire space and to share with participating audiences practices that bring into play the principles of improvisation and mutual listening within a group" (Bétonsalon Center for Art and Research, 2023). The works by the artists taking part in the exhibition were presented in a collective programme that brought together various installations, workshops and performance-based initiatives, as well as other regular sessions dedicated to the experience of the Sonic Meditations (see Fig. 4). Therefore, Pauline Oliveros' work became a kind of catalyst for collective thinking involving artists, researchers, participating audiences and the organising team. Taken as a whole, the project would provide a comprehensive insight into how Deep Listening can bring about transformation at both a personal and a social level.



Fig. 4. Sharing session of Emily Mast's workshop, during the exhibition *Un-Tuning Together. Practicing Listening with Pauline Oliveros*. Bétonsalon Center for Art and Research, Paris, 2023. (Photo by Susie Richard: <https://www.betonsalon.net/en/expositions/un%C2%B7tuning-together-pratiquer-lecoute-avec-pauline-oliveros/>)

Within a closer context, we would like to mention the work of sound designer, artist and researcher Ilaria Degradi whose doctoral thesis, *Soundscapes: Unusual Territories for Experimental Electronic Music* (2025), explores how

sound art can be used as a tool for social transformation to enhance the value of abandoned spaces and revitalise them. The Italian artist living in Andalusia is specialised in field recordings and digital instruments. Degradi focuses her work on the production of electronic music and soundscapes. And through her project *Music for Territories*, based on the practice of deep listening and different sound experimentations, she promotes the reconnection of communities with their environmental surroundings, emphasising the need for cooperation and reconnection with nature, developing what could be defined as an artistic practice based on an ecofeminist perspective (see Fig. 5).



Fig. 5. Ilaria Degradi, *Music for Territories* (Ilaria Degradi (2025). *Territorios Sonoros. Territorios inusuales para la música electrónica experimental*. [Doctoral Thesis, University of Jaen, Spain]. Courtesy of the artist: <https://ruja.ujaen.es/items/a2e066fa-dd11-4bc6-a3a8-8fb17ba0bc45>)

The combination of her interest in experimental electronic music and in neglected or forgotten tangible and intangible heritage has given rise to a sound project aimed at giving a voice and visibility to silenced places and cultures through the creation of unique soundscapes and unusual settings. In the creation of her works, the methodology employed begins with soundwalking and field recording, moves on to the interpretation of the recorded material using digital tools and synthesisers, and culminates in site-specific sound installations.

Recently, Degradi presented the audiovisual installation entitled *Suburban Soundscape* (2024) in the Chapel Hall of the School of Architecture at the University of Granada, as part of the 10th International A/R/Tographic Video

Narrative Exhibition. The collaboration featured an original video work by Eugenio Rivas and a soundscape performed live by Degradi. The result presented an evolution of the previous work *My Neighbourhood, My Garden* (Rivas, 2023), created in collaboration with the artistic collective Artefacto Social, which, through a participatory strategy, brought together a large collection of plant pots lent by residents of a working-class neighbourhood in the city of Málaga (Spain). This sound garden explores community interdependence from an ecological perspective, building on previous research and social engagement.

Conclusions

Sound exploration based on this practice of attention without limits or distinctions recognizes the power of pause for care, establishing a methodological model of cooperative experimentation through sound. This kind of listening reinforces social commitment and connects with an intersectional and ecofeminist perspective, allowing us to recognize the interdependence and eco-dependence of all beings as part of a reality characterized by indeterminacy. A situated listening has the power to highlight unheard realities, influencing their context from a social, political, or ecological perspective.

Coming back to Oliveros's work, it is worth revisiting *Sonic Meditations* (1971). This collection of exercises, designed for group work within regular meetings over a long period of time, constitutes an inclusive way to participate in a collective experience and share the healing power of music or sound. As Oliveros noted, with continuous work, some significant results can be achieved, developing elevated states of awareness or expanded consciousness, and experiencing changes in physiology and psychology from known and unknown tensions. These changes may represent a tuning of mind and body, establishing strong connections between group members, through the exchange of positive energy, and constituting a source of empathy towards other forms of existence.

Irene Revell (2022) considers the textual instructional performance score as a feminist project. The collection itself is always speculative feminist, what has to do with the contemporary feminist new materialism promoted by Karen Barad. Revell defends the indeterminate, *in-between* and performative nature of Oliveros's work. And argues that such score-based performance works are diffractive: "That is to say that they open outwards to others in their multiple iterations in time and space, sharing authorship and labour, reinforcing the inherently speculative nature of any coherent understanding of their aesthetic" (Revell, 2022, p. 282). Listening became a way to know (Moore & Wright, 2025, p. 176), in a transcorporeal listening that involves and holds indeterminacy as critical to its formation: "Trans-corporeality means that all creatures, as embodied beings, are intermeshed with the Dynamic, material world, which crosses through them, transforms them, and is transformed by them" (Alaimo, 2018, p. 435). Deep Listening thereby becomes an act of love, in which one pays attention to the other from a sense of absolute

interdependence. Thus, through collective listening, the capacity to love many others is put into practice, in a process of knowledge-building which, going beyond social involvement, establishes an ecological and feminist commitment through socio-cultural action.

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Author Contribution

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Author 1: Conceptualization, investigation, methodology, visualization and writing.

Author 2: Conceptualization, investigation, methodology, visualization and writing.

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Women in Communication Research: A Thematic and Epistemological Analysis from a Gender Perspective

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Abstract: This study analyses the presence of women as an object of research in the field of communication from a gender perspective. A mixed-method approach is employed, combining a systematic literature review and a content analysis of 350 articles indexed in Scopus during 2025, selected using the search terms “women” and “communication.” The results show that research is mainly concentrated on the geographical origin of the women studied, health-related topics, and analyses of women's participation in roles traditionally associated with men. Other areas addressed include sexuality, social vulnerability, the digital environment, and language. However, studies specifically focused on gender equality and women's empowerment remain a minority. In conclusion, although women increasingly appear as a focus of analysis in communication research, traditional thematic approaches persist, and perspectives that more deeply challenge gender structures in knowledge production remain limited.

Keywords: Gender perspective; women in communication research; scientific production; content analysis; gender equality.

Introduction

Communication studies from a gender perspective draw on diverse and critical feminist traditions (Vázquez González & Cárdenes Hernández, 2021). Among them, Feminist Standpoint Theory, developed by authors such as Sandra Harding, argues that all knowledge is produced from socially situated positions. Traditional science, historically configured within male-dominated spaces of power, has tended to construct an androcentric perspective that

presents itself as universal (Silvestre Cabrera et al., 2020). In response, Harding (1993, p. 69) proposes the notion of “strong objectivity,” according to which incorporating historically marginalized experiences does not introduce bias but rather enables more comprehensive and less distorted knowledge. This perspective challenges the supposed neutrality of scientific knowledge and demonstrates that dominant epistemological frameworks have privileged forms of rationality associated with masculinity while marginalizing alternative ways of knowing.

Within this same critical tradition, intersectional feminism, formulated by Crenshaw (1989), expands the analysis by emphasizing that gender does not operate in isolation but interacts with other structuring categories such as race, social class, sexual orientation, and nationality. Intersectionality makes it possible to understand how systems of oppression intersect and generate specific forms of inequality. This approach is particularly relevant in communication studies, where media and academic discourses may simultaneously reproduce multiple hierarchies.

From this theoretical framework, the literature has documented the ambivalent position of women in academic production in the field of communication. Despite the growing feminization of the discipline, dynamics of symbolic invisibilization and unequal recognition persist (Garzón & Quisimalín Santamaría, 2025; Minchola et al., 2024). The so-called “Matilda effect” describes the systematic tendency to undervalue or attribute to male colleagues the scientific contributions made by women (García-Jiménez et al., 2022). In the field of Ibero-American communication studies, Segado-Boj et al. (2021) show through network analysis that although there are female researchers occupying central positions, the overall structure of scientific communities continues to be organized around male authors, relegating many women to peripheral positions. This inequality is reflected not only in bibliometric indicators (such as citations or project leadership) but also in the configuration of research agendas and in the criteria used to define academic prestige (Palomo-Domínguez et al., 2024).

Similarly, topics related to women tend to concentrate in specific areas, such as female media representations or gender-based violence, often approached through stereotyped frameworks (Salinas-Vázquez et al., 2026). Researching communication from a gender perspective therefore involves critically examining the degree of heteronormativity present in both media and academic discourses. The theoretical and methodological decisions adopted in research may contribute either to dismantling gender inequality or to reproducing it. Consequently, the absence of a gender perspective does not constitute methodological neutrality but rather a position that perpetuates androcentric bias (UPF, 2017).

The concept of a gender perspective in science involves recognizing gender as a cross-cutting analytical variable throughout all stages of the research process. The ICM (2022) emphasizes that integrating this perspective

improves the quality, rigor, reproducibility, and creativity of research. In the field of communication, this implies analysing how discourses construct identities, roles, and hierarchies, and assessing the extent to which they reproduce or challenge gender-based power structures. Thus, a gender perspective is not limited to quantifying the presence of women in scientific authorship but also interrogates the epistemic logics, disciplinary criteria, and interpretative frameworks that shape knowledge production (ICM, 2022).

In the Spanish context, although women represent approximately 42% of research personnel (a figure higher than the European average) this quantitative presence does not automatically translate into research conducted from a gender perspective (Ecoavant, 2023; RTVE, 2017). Studies in the field of communication indicate that research with a gender approach remains a minority and is primarily carried out by women. This reinforces the idea that the analysis of inequality continues to fall disproportionately on those who experience it. This situation highlights that numerical equality alone does not guarantee epistemological transformation. This example is offered as illustrative of a broader pattern observed across various national contexts.

Within this context, the present study is based on the premise that making women visible (both as researchers and as subjects and objects of analysis) is a necessary condition for expanding and enriching scientific knowledge in communication. The general objective is to determine when, how, and in which areas women appear as the focus of analysis in academic production in the field, identifying possible thematic concentrations and evaluating their epistemological implications.

Methodology

This research adopts a mixed-methods methodological approach that combines quantitative and qualitative techniques in order to obtain a comprehensive understanding of how women are treated as objects of study in academic research in communication. The combination of these approaches allows not only the identification of patterns and trends in scientific production but also the interpretation of their meaning and implications within the field of communication. Such a design is particularly appropriate in bibliometric and content-analysis studies, as it enables the integration of systematic quantitative data with contextualized interpretations of the phenomena analysed (Creswell & Plano Clark, 2018; Krippendorff, 2019; Sáenz-Torralba et al., 2025).

The study is structured in two complementary phases. In the first phase, a systematic review of the scientific literature was conducted to identify research related to women and communication. The search was carried out in the Scopus database in 2025 due to its extensive coverage of international

scientific publications and its frequent use in bibliometric studies in the social sciences. Document retrieval was performed by searching the title, abstract, and keywords fields using the terms “women” AND “communication” in order to locate studies explicitly addressing the relationship between these two concepts. Additionally, a filter was applied to include only publications within the “Social Sciences” category. This procedure initially yielded a total of $N = 955$ records.

Subsequently, a process of data cleaning and sample selection was conducted to ensure that the documents included corresponded to the specific focus of the study. The inclusion criterion required that women constitute the primary object of analysis. In other words, studies in which women appeared only as a secondary component of the sample or merely as another demographic variable were excluded. To facilitate classification and optimize the filtering process, the artificial intelligence tool Gemini was used, enabling a more precise identification of articles whose analytical focus explicitly centred on women. After this selection process, the final sample used in the research was established. Within this sample, a specific subgroup of studies related to artificial intelligence and digital technologies applied to communication was identified, representing a relevant subset for analysis. This subgroup includes a total of $N = 672$ documents.

At the initial stage of the study, all articles published during the year under analysis were collected. However, after a preliminary review it was observed that thematic and discursive patterns were consistently repeated throughout the period. For this reason, and in order to optimize the analytical process without compromising the representativeness of the sample, the study focused on the first six months of the year.

The selection of this period was justified because the articles published during this interval presented the same trends, approaches, and structures observed throughout the rest of the year, and were therefore considered representative of the overall dataset. This strategy allowed for a more detailed analysis while maintaining the validity of the study. Consequently, the final sample includes a total of $N = 350$ documents.

In the second phase, a content analysis of the selected articles was conducted. Content analysis is one of the most widely used techniques for systematically examining large volumes of textual information, allowing researchers to identify thematic categories, discursive patterns, and trends in scientific production (Krippendorff, 2019; Neuendorf, 2017). In this case, the analysis combined a quantitative coding process with a subsequent qualitative interpretation of the results.

To this end, a system of thematic categories was designed to classify the main approaches through which women are addressed in communication research. These categories were defined based on a preliminary literature review and an inductive process derived from the initial exploration of the

articles included in the sample. The main categories analysed include the geographical origin of the women studied, health-related studies, analyses of sexuality, research focusing on male roles in relation to women, studies addressing situations of vulnerability, research focusing exclusively on women, sociolinguistic content, studies related to digital and technological environments, and research addressing issues of equality and empowerment.

Each article included in the sample was coded according to these categories, making it possible to quantify the frequency with which specific thematic approaches appear in academic communication research. Subsequently, the quantitative results were interpreted from a qualitative perspective in order to understand which types of representations and approaches predominate when women are placed at the centre of scientific analysis.

Results

Relevance of Place of Origin

The analysis of the documents included in the sample revealed that a large proportion of them explicitly mention the geographical origin of the women involved in the studies. Locations cited include diverse contexts such as *Pakistan, Tel Aviv, Afghanistan, Latin American women, Uganda, India, Spanish women*, and the *United States*, among others.

Highlighting origin is directly related to the fact that it may be associated with different cultural, social, and even educational contexts, which in turn may influence behaviours, perceptions, experiences, and access to resources.

In this regard, 105 documents in the sample consider the geographical origin of the women included, representing 24.9% of the total and constituting the most numerous categories (see Fig. 1).

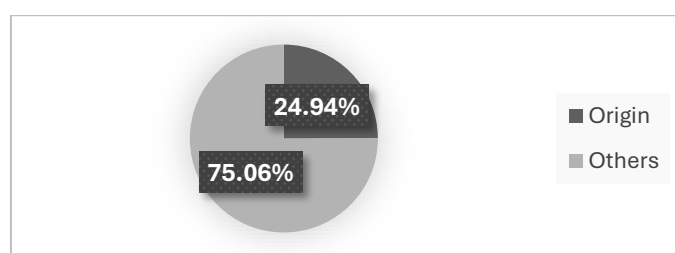


Fig. 1. Representation of the category “place of origin”

Therefore, considering the origin of the women included in the study sample makes it possible to interpret results within a specific social and cultural context that may shape research outcomes. It also allows for the identification of variations or patterns across different groups of women. These similarities or differences may be explained by cultural norms, socioeconomic conditions, educational or healthcare systems (analysed in another section of this study),

public policies in each region, and other contextual factors linked to geographical origin.

The Importance of Health-Related Topics

The second most prominent category consists of documents addressing issues related to women's health. Biological differences between men and women, as well as the fact that female health influences many aspects of women's lives, make this variable an important field of study. These particularities may affect women's circumstances as a group, just as being a woman may determine the onset, progression, or treatment of certain diseases.

In many contexts, gender inequalities exist in access to healthcare, as well as in the diagnosis and treatment of illnesses. Studying health allows researchers to identify potential gaps or inequalities that specifically affect women.

Moreover, women's health is also influenced by social, cultural, and economic factors, which can affect both physical and mental well-being.

Research on health-related topics helps to make visible issues that particularly affect women, such as reproductive health, maternal health, or diseases with higher prevalence among women.

Among the items associated with women and health in the analysed documents are *menstrual cycle*, *cervical cancer*, *pregnancy testing*, *incarcerated mothers*, *contraceptives*, and *menopause*, among others. A total of 76 documents in the sample address health-related issues, representing 18.05% of the total, making this the second largest category (see Fig. 2).

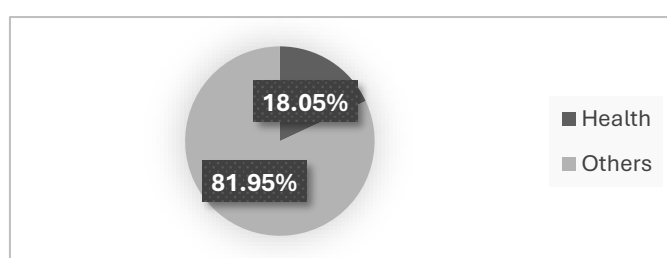


Fig. 2. Graphical representation of health-related topics

Sexuality and Women

Although this topic may overlap with the previous category related to women's health, sexuality deserves specific attention in studies focused on women. While smaller in number, 30 of the analysed documents address sexual topics, and they are nevertheless highly significant within the final sample.

This demonstrates that examining sexuality in women-centred research helps to understand how female sexual experiences are socially and culturally

constructed, as well as to identify potential inequalities, representations, and discourses that influence women's well-being and autonomy in relation to men.

Throughout history, female sexuality has been shaped by social, cultural, and gender norms. Studying this issue therefore allows for the identification of how these factors influence women's experiences. Female sexuality is often surrounded by taboos, stigmatization, and inequalities; analysing this topic helps to make these dynamics visible.

For this reason, it has been included as one of the study categories. Within this category, topics such as *romantic relationships*, *sexual pleasure*, *family planning*, *marital quality*, and *sexual dissatisfaction* were identified.

From the total sample, 30 studies relate to sexuality, representing 7.13% of the total (see Fig. 3).

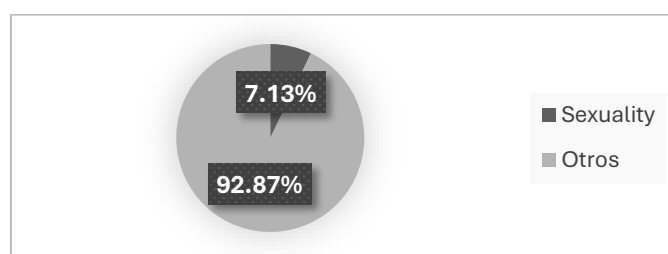


Fig. 3. Visual representation of sexual topics

Topics in Historically Masculinized Fields

Analysing roles traditionally associated with men that are now also linked to women allows researchers to identify transformations in gender roles, question stereotypes, and understand how female representation and participation in different social spheres are being redefined.

Therefore, it is significant to determine how many studies that place women at the centre of analysis are directly related to the social changes that have positioned women in activities historically associated with men.

Studying these roles helps identify whether traditional gender stereotypes are being broken or whether limits and resistance still exist in the ways women are represented or socially accepted. It also helps explain how female identities are being redefined and what new models of womanhood appear in society or within the analysed discourses.

In the specific case of this research, the results show that 63 studies (14.96% of the total) (see Fig. 4) address topics related to women's social roles in historically masculinized fields.

Among the topics included in this category are *female political candidates*, *women in government*, *women academics*, *local women in leadership roles*,

women in professional leadership positions, and women in institutional positions.

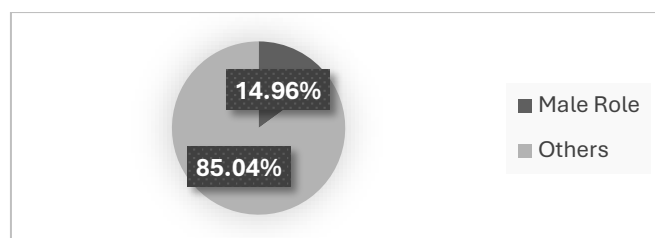


Fig. 4. Graphical representation of women's presence in historically masculinized fields

Vulnerability and Women

Analysing vulnerability in women-centred studies makes it possible to identify structural inequalities and social factors that may place women in situations of greater risk or disadvantage. This variable is relevant for understanding how gender dynamics influence women's living conditions and experiences.

Examining vulnerability is important because it allows for a deeper understanding of the social, economic, and cultural conditions that may place women at greater risk in certain contexts.

In this study, research focusing on women in vulnerable situations was included. Examples include *incarcerated Aboriginal mothers, rural women, women of colour with autoimmune diseases, migrant women, refugee women, violence along migration routes, and women prisoners*.

Overall, 35 studies address situations of vulnerability among women, representing 8.3% of the total sample (see Fig. 5).

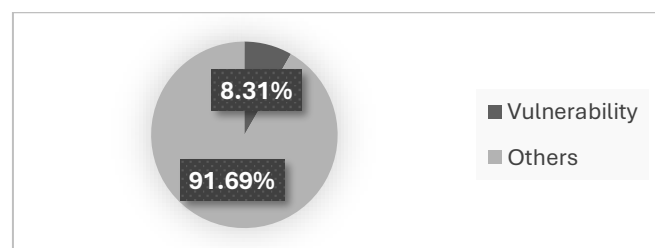


Fig. 5. Female vulnerability represented in studies on women

Experiences and Conditions Socially Associated with Women

As mentioned in previous sections, certain experiences and conditions are disproportionately associated with women due to a combination of biological and sociocultural factors. In this context, analysing these socially situated experiences helps to understand the particularities that may influence women's life circumstances, without assuming that such experiences are universal or biologically determined.

These experiences are shaped by the interaction between biological factors and social, cultural, and institutional contexts, making it necessary to consider them in order to interpret study results accurately.

Analysing these experiences in scientific research is important because it allows for a better understanding of the biological, social, and cultural factors that may influence women's experiences, behaviours, or living conditions—factors that are always mediated by specific social and historical contexts.

It should be noted that the topics grouped under this category—ranging from reproductive health and motherhood to medical technologies and sexual violence—are analytically diverse. Their inclusion within a single category reflects a grouping based on their shared presence in the reviewed literature, not a claim that these are inherently or universally female experiences. They are better understood as areas where women appear disproportionately as research subjects due to intersecting social, biological, and structural conditions.

In this study, several topics were identified within this category, including *pregnant women, postnatal care, mothers, contraceptive pills, traumatic childbirth, reproductive health, HIV during childbirth, and sexual violence*.

In total, 42 of the analysed studies include themes related to characteristics specific to women, representing 9.98% of the sample (see Fig. 6).

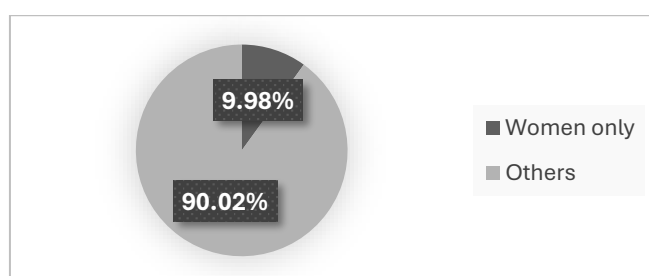


Fig. 6. Graphical representation of socially situated experiences of women

Gender and Sociolinguistics

Sociolinguistic analysis makes it possible to examine how gender influences language use and the construction of discourses about women. Differences between men and women in the linguistic domain are often linked to social, cultural, and socialization factors that shape communication practices and gender representations.

Sociolinguistics studies how social factors (such as gender, age, social class, or cultural context) influence language use. Analysing this dimension in research on women allows us to observe how identities and experiences are constructed and expressed through language.

In the analysis of the documents included in this study, several works addressing women were directly related to sociolinguistic topics, including

hate speech, corporate language, linguistic sexism, sexist language on Twitter, and language and analgesia.

Overall, 19 of the 350 analysed studies are related to language issues (see Fig. 7).

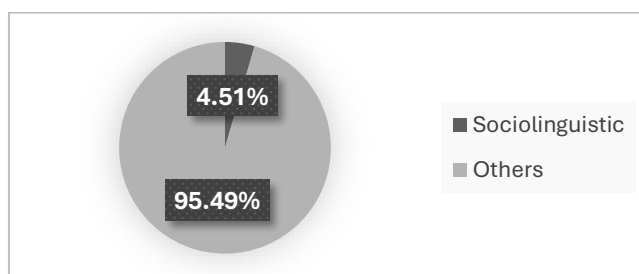


Fig. 7. Visual representation of sociolinguistic studies

The Digital Dimension as a Gender-Differentiating Component

Currently, scientific research increasingly includes the digital sphere as an object of study because a significant portion of social interaction and identity construction takes place within these spaces. Digital environments provide valuable data for understanding contemporary social phenomena more comprehensively.

In the specific case of this study, analysing the digital dimension allows researchers to examine how women represent themselves, express themselves, and participate in virtual environments, as well as to identify associated opportunities and risks.

Digital tools affect multiple aspects of daily life, including education, work, communication, information consumption, and socialization. Therefore, understanding their specific impact on women is relevant and explains why this dimension appears prominently in the analyzed documents. In fact, 40 of the included studies (9.5% of the total) have some connection with the digital sphere (see Fig. 8).

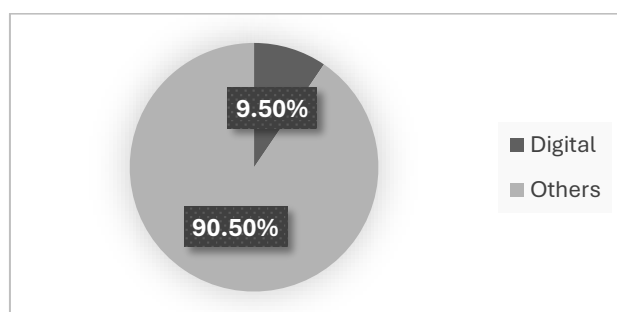


Fig. 8. Studies related to digital environments

Topics included in this category include *social media and communication, digital divide, digital literacy among girls, digital literacy among rural*

women, menstruation tracking apps, emojis and female friendship, and FOMO and sexting among young people, among others.

Equality and Female Empowerment

Studying equality and female empowerment in scientific research focused on women is essential because it helps explain how gender relations are constructed, negotiated, and transformed, and how women gain access to opportunities, rights, and spaces for participation that were previously restricted.

Although it might initially seem that a large proportion of studies focusing on women would address empowerment, the data show otherwise. When analysed as an independent category, it is the least represented theme, as only 11 of the 350 studies included in the sample address this specific topic.

Within this 2.6% of the total sample, topics include *gender empowerment on Twitter*, *authenticity among women politicians*, *autonomy and clothing among noble women*, and *gender equality and empowerment among women pharmacists*.

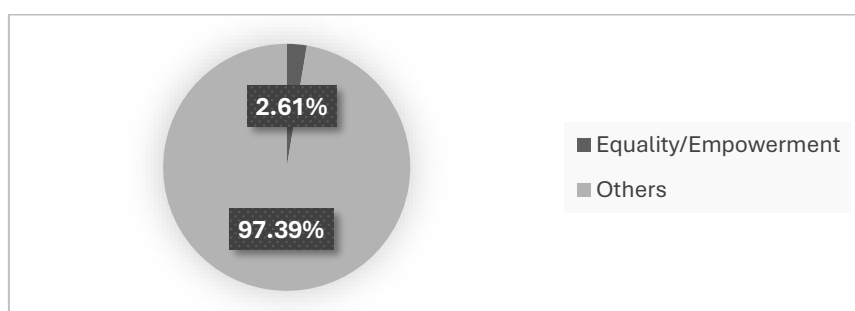


Fig. 9. Visual representation of studies addressing female empowerment

Overall Analysis of Results

The results show that a significant body of research focused on women incorporates the geographical origin of study samples, revealing notable disparities depending on the participants' location. This highlights the importance of considering territorial context when interpreting research findings.

Regarding the topics studied, health-related issues constitute the most prominent thematic area within research on women and communication, indicating a predominant interest in addressing issues related to women's physical and social well-being. Another notable trend is the growing body of research examining women in roles historically associated with men, demonstrating how transformations in gender patterns are increasingly documented and analysed.

On the other hand, and contrary to initial expectations, studies addressing gender equality and female empowerment do not represent a statistically

significant proportion of the total sample. This suggests that, despite their social relevance, these themes remain underrepresented in the scientific literature reviewed.

Overall, these results make it possible to identify areas of concentration and thematic gaps in research on women, providing a general overview of prevailing trends and highlighting aspects that require greater attention in future studies, as illustrated in the following figure.

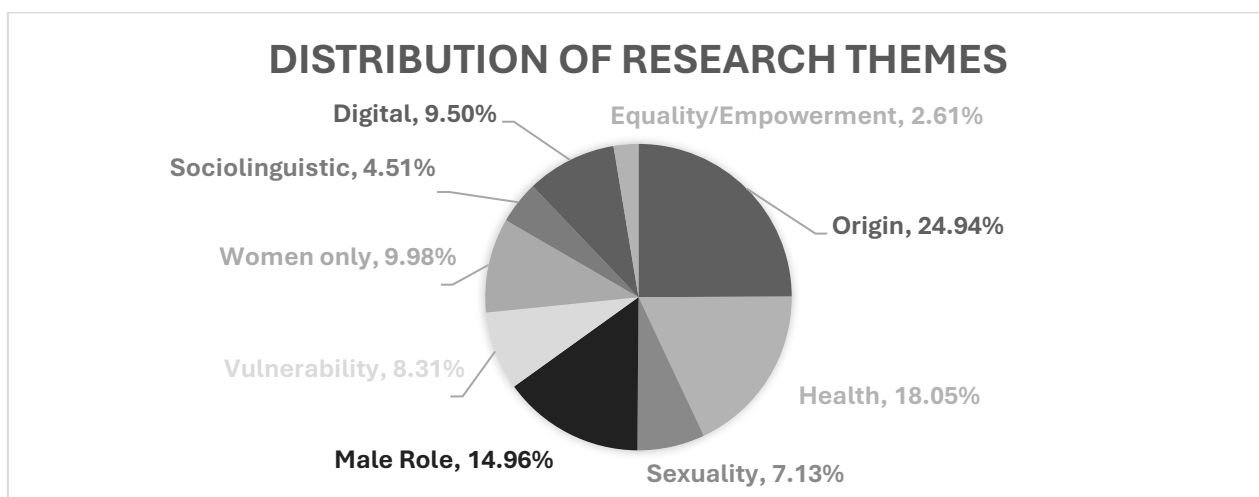


Fig. 10. Global representation of research results

Discussion

The analysis of the works included in this research sample indicates that women are indeed placed at the centre of many studies; however, these studies often still focus on topics with a strong gendered orientation. The findings therefore highlight a complex reality: although women have a significant presence in communication research, the ways in which they are studied still reflect traditional patterns.

This is evident in the prominence given to the geographical origin of the analysed samples, which constitutes the most frequent category in the dataset. These findings support the notion that territorial origin is fundamental for interpreting results within a specific social and cultural context. Factors such as local norms, educational systems, and socioeconomic conditions shape women's experiences in distinct ways.

Regarding dominant thematic areas, health emerges as the second major axis of research on women. This interest focuses primarily on highlighting gender gaps in healthcare access and on analysing specific biological and social conditions, such as reproductive and maternal health.

At the same time, the study also reflects an evolution in the academic agenda, as it documents a significant number of studies examining women's

participation in historically masculinized roles. Research on institutional leadership, political candidacies, and professional success suggests an effort to record the breaking of traditional stereotypes and the redefinition of female identities in contemporary discourse.

Furthermore, the digital dimension has become a transversal factor that allows scholars to analyze how women navigate virtual spaces, facing both risks (such as the digital divide and hate speech) and opportunities for socialization and health management.

Similarly, the focus on vulnerability provides a framework for examining structural inequalities affecting specific groups, including migrant women, refugees, and incarcerated women, thus offering an important perspective on marginalization within scientific research.

Conclusions

The findings of this study reveal a consistent pattern in how women are positioned as objects of analysis in communication research: they appear predominantly in thematically bounded areas—geographical origin, health, and vulnerability—that, while academically relevant, tend to reproduce rather than challenge established frameworks for studying women. The underrepresentation of gender equality and empowerment as research topics is particularly striking, as it suggests that even studies explicitly centred on women do not systematically adopt a transformative gender perspective. This points to a broader tension within the field between the quantitative inclusion of women as research subjects and the qualitative shift required to produce genuinely feminist knowledge.

This study is not without limitations. The corpus is restricted to a single database (Scopus) and to a six-month window of publications, which, while justified by the observed thematic saturation, may not fully capture the diversity of research produced across the entire year or in journals not indexed in that platform. Additionally, the search was conducted using only two terms ("women" and "communication"), which inevitably excludes studies that address related phenomena under different terminology. The analytical categories, while grounded in both the existing literature and an inductive exploration of the corpus, reflect interpretive decisions that other researchers might configure differently. These limitations should be considered when generalizing the findings beyond the specific scope of this study.

Future research should address these limitations by expanding the corpus to include additional databases such as Web of Science or Google Scholar, and by incorporating longitudinal analyses that track how thematic trends in women-centred communication research evolve over time. It would also be valuable to examine the relationship between the gender of the authorship and the thematic orientation of the studies, to assess whether and how

feminist perspectives are more consistently present when women occupy leading roles in research teams. Finally, applying a more explicitly intersectional framework to the classification of topics could offer a richer understanding of how race, class, nationality, and other structural categories intersect with gender in shaping both research agendas and the experiences of the women studied.

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Author Contribution

Author 1: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Writing – original draft.

Author 2: Conceptualization, Investigation, Methodology, Resources, Software, Validation, Writing – original draft, Writing – review & editing.

Author 3: Validation, Visualization, Writing – review & editing.

Tools of Artificial Intelligence

No AI tools were used in preparing this research.

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Editorial Practices in Gender Equality by the Spanish Foundation for Science and Technology (FECYT)

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Abstract. The FECYT awards the Quality Seal and the Mention of Good Publishing Practices in Gender Equality (MGPPGE) to scientific journals with the aim of eliminating structural gaps and establishing equality as the norm. We analyse the 2018–2023 evolution of the MGPPGE in the social sciences and humanities and evaluate the effectiveness of the procedure for awarding the MGPPGE through a case study of the journal *IROCAMM*. Of the 581 journals analysed, only 36.7 % held the MGPPGE. The number of journals with a mention is growing (22.7 % in 2018 and 47.5% in 2023). Education and Communication had the highest number of mentions (31.5 % and 29.6 %), far ahead of Archaeology (20.2 %) or Fine Arts (18.8 %). The percentages of journals with MGPPGE are higher in journals in the lower quartiles: 41.67 % in Q3 and 39.19 % in Q4. *IROCAMM*'s trajectory meets the parity criteria but does not achieve MGPPGE in 2025 given the sample of articles used in the call for applications.

Keywords: Scientific journals; inclusive science; public policy; scientific quality; #nomásMatildas.

Introduction

Despite the introduction of legislation such as Organic Law 3/2007 on effective equality between women and men and Organic Law 2/2024 on equal representation and a balanced presence of women and men, amongst others, gender inequalities remain a reality that affects all spheres of life, and scientific and academic institutions are no exception. Jaramillo et al. (2025) highlight the under-representation of women in both teaching and research, particularly in STEM (Science, Technology, Engineering, Mathematics) fields (Epifanio & Calvo-Iglesias, 2024).

The CRUE (Confederation of Rectors of Spanish Universities) does not reflect gender-inclusive language in its name —specifically, it uses the masculine form *rectores* and does not include the feminine *rectoras*—, despite the fact

that 25 % of Spanish universities have a female rector at the heart of their institutional hierarchy. Therefore, if within such a structural system the institutions themselves tend to be unequal, it is hardly surprising that, firstly, the other dependent bodies, such as university journals, perpetuate the imbalance and, secondly, begin to operate, among others, bodies such as the Network of Gender Equality Units for University Excellence (RUIGEU), which brings together the units, offices, observatories, commissions and secretariats for equal opportunities between women and men from Spanish public universities and those private institutions that apply for membership. The fact that the editorial boards of scientific journals in Medicine (Amrein et al., 2011; Erren et al., 2014; Østby et al., 2013), Psychology (González Sala and Osca-Lluch, 2018) and Biomedicine (Huamán-Guerrero & Cruz-Vargas, 2016), amongst others, have higher proportions of men on their editorial and scientific teams, as well as in peer review and authorship roles, is not an isolated phenomenon.

As specialised communication channels, managed predominantly with public funds and by public institutions, scientific journals must promote gender equality comprehensively, from their editorial policies to their review and publication processes (Coslado et al., 2023) and the use of inclusive language. The fact is that scientific journals must integrate both women and men into their messages and content, understood as facilitators and shapers of future knowledge. This is not a utopian ideal. Segarra-Saavedra et al. (2021) note that among scientific journals in the field of Communication, the promotion and use of inclusive and non-sexist language is on the rise, just as Lange & von Stockhausen (2025) observe that its use is also growing at a general level, and Borito (2023) notes this trend in internal university communications.

In this regard, initiatives such as those by Borrell et al. (2015) seek to promote gender equality in scientific publication and dissemination in the case of the journal *Gaceta Sanitaria*, addressing key aspects such as authorship, terminology and inclusive language, metadata, and other elements of the scientific structure; or those by Heidari et al. (2016) who, through the SAGER guidelines—developed by the Gender Policy Committee established in 2012 by the European Association of Scientific Publishers—set out guidelines for conducting analyses disaggregated by sex/gender.

Aguillo (2025), for his part, aims to raise the profile of women researchers and their impact as measured by citations through the study of their profiles on Google Scholar with an ORCID identifier (N=11,000), covering both Spanish women conducting research in Spain and abroad, as well as foreign women researchers affiliated with a Spanish institution. Notable figures include Vasili A Mitsou (CSIC, 315.899) and María Moreno Llácer (University of Valencia, 247.295).

At an institutional level, the Spanish Foundation for Science and Technology (FECYT), which has been responsible since 2001 for assessing the editorial and scientific quality of scientific journals, also aims to eliminate structural gender gaps in the field of research and to promote equality as a standard of academic excellence by awarding a 'Mention of Good Editorial Practices in Gender Equality' (MGPPGE). This mention is awarded to journals that meet at least three of the following requirements: 1) gender parity in governing bodies;

2) gender parity in peer review and inclusive authorship policies; 3) publication of authorship statistics disaggregated by sex; and 4) promotion of the inclusion of authors' full first names rather than initials; and two of the following three requirements: 1) promoting inclusive language through their editorial policy recommendations; 2) recommending sex/gender-disaggregated analysis across all work; 3) including the assessment of the gender perspective in the review of work and evaluation reports (FECYT, 2022).

These clearly defined criteria are intended to ensure that the measures are not purely quantitative but also qualitative. However, despite growing institutional attention to gender equality in scientific publishing, there is still little empirical evidence regarding the development and ease of actual implementation of these good practices within the Spanish journal system which, despite its egalitarian structure in its management team, still does not meet the requirements linked to promoting the inclusion of a gender perspective in research, as well as the use of inclusive language.

In light of this situation and within this context, this research aims to analyse the presence and evolution of the MGPPGE in Spanish scientific journals in the social sciences and humanities, taking into account temporal, disciplinary and quartile ranking variables, and to assess the ease of implementation of the procedure for awarding the Mention of Good Editorial Practices in Gender Equality (MGPPGE) through a case study of the journal *IROCAMM*, a candidate for the MGPPGE in 2025.

Methodology

A descriptive and longitudinal analysis is carried out of the trends in the awarding of the FECYT Quality Seal and the Mention of Good Publishing Practices in Gender Equality (MGPPGE) to Spanish scientific journals in the field of Social Sciences and Humanities. Using a database created specifically for this purpose based on the Classification of Visibility and Impact of Spanish Scientific Journals with the FECYT Quality Seal, information was compiled regarding the journal's field of knowledge, the year of evaluation, the quartile in which the journal is classified, the score awarded, whether it holds the MGPPGE, and the year. The information was compiled in December 2025, using data from the period between 2018 and 2023.

With regard to the journal *IROCAMM*, information was compiled covering its entire publishing history, that is, for the period between 2018 and 2025, relating to: 1) gender parity across different areas (the number of women in roles such as authorship, peer review, the editorial board and the scientific committee); 2) visibility (inclusion of the full first names of the authors of the articles) and 3) recommendations (inclusive language in its editorial policy, sex/gender-disaggregated analysis across the entire work, and inclusion of gender perspective assessment in the peer review and evaluation reports).

The statistical software Jamovi was used for the quantitative analysis, and ChatGPT was used to verify the results.

Results

Of the total number of unique journals analysed (N=581), only 36.7 % were mentioned in the MGPPGE. Analysis by year shows that, over the study period, there has been a gradual increase in the number of journals receiving this mention, rising from 10 in 2018 to 85 in 2023 (see Fig. 1).

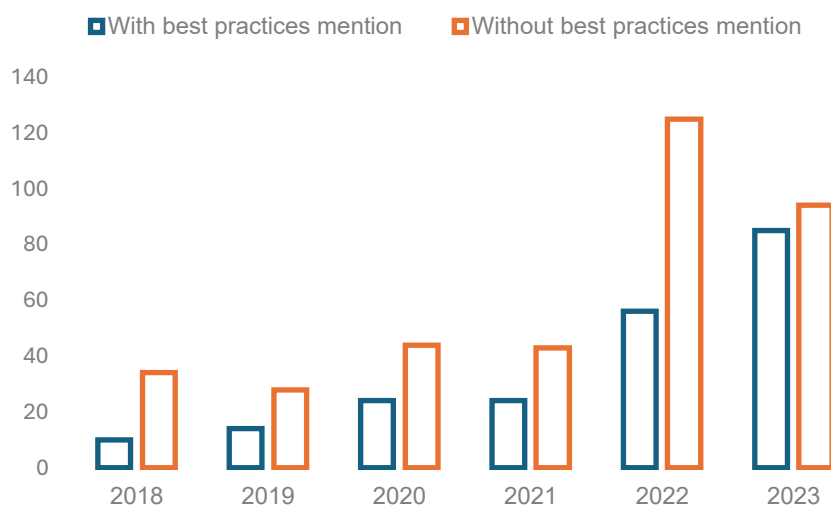


Fig. 1. Absolute frequencies of Spanish scientific journals with and without mention of editorial best practices in gender equality

However, as the sample is unbalanced (varying by year), the relative analysis also shows that the increase has been gradual, rising from 22.7 % of journals with MGPPGE in 2018 to 47.5 % in 2023, with this upward trend being statistically significant ($Z = 2.78$; $p = 0.005$) (see Fig. 2).

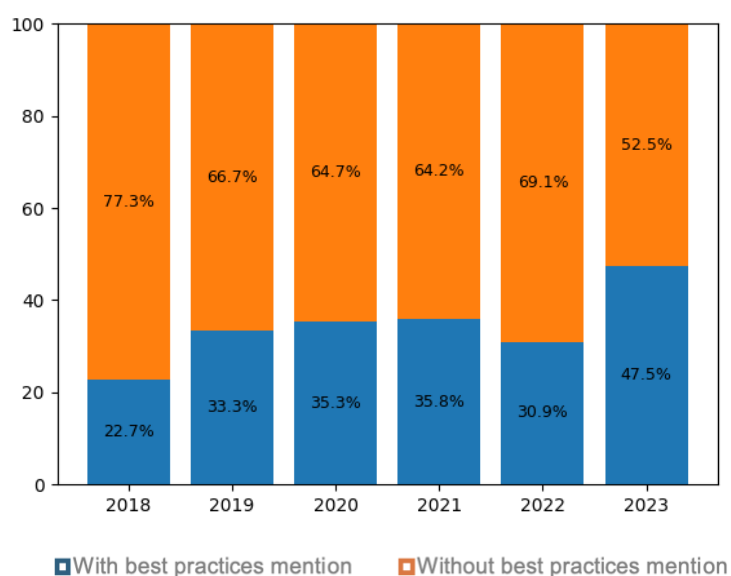


Fig. 2. Relative frequencies of Spanish scientific journals with and without mention of editorial best practices in gender equality

With regard to differences by subject area, there are notable variations depending on the field of study, with journals in the Education and Communication categories accounting for the highest number of total (MGPPGE) mentions (31.5 % and 29.6 % respectively), far ahead of journals in other disciplines such as Archaeology (20.2 %) or Fine Arts (18.8 %), with this difference being statistically significant ($\chi^2 = 11.73$; $p = 0.008$) (see Fig. 3). However, it should be noted that this latter field of knowledge has seen a notable increase in (MGPPGE) mentions between 2022 and 2023, placing it almost on a par with Communication journals and surpassing the fields of Education Sciences and Archaeology in percentage terms.

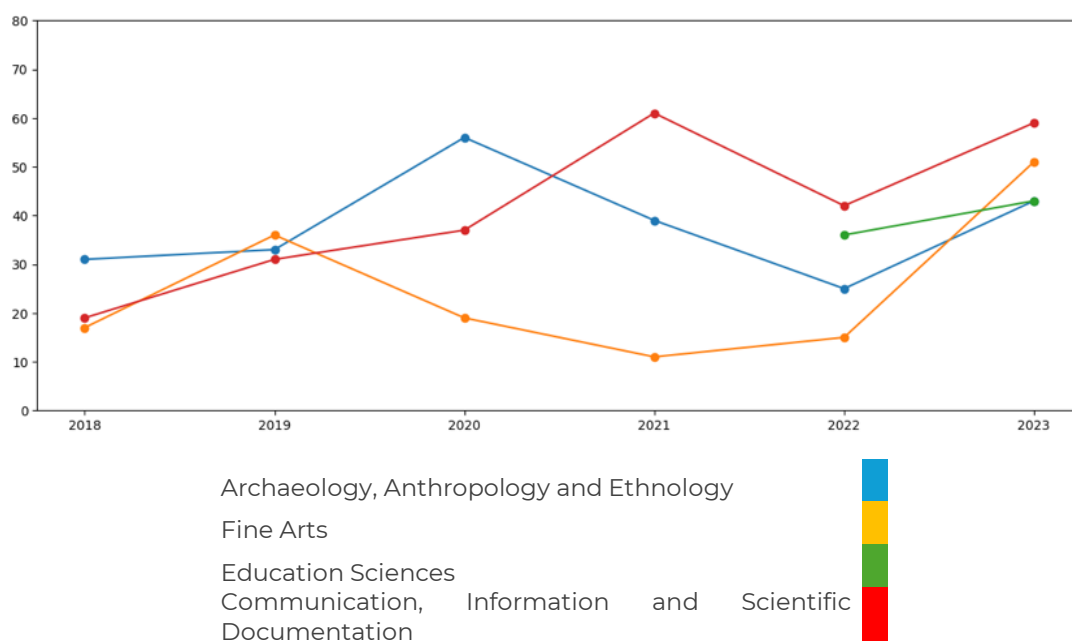


Fig. 3. Relative percentages of mentions of good publishing practices by subject area

When we assess the number of (MGPPGE) mentions per journal impact factor, we see that the proportion of journals with MGPPGE is higher among those in the lowest quartiles, totalling 41.67 % for journals classified as Q3 and 39.19 % for Q4.

Finally, when we analyse the transitions of journals over time, the data show that the most common outcome is for journals to maintain their previous status (68.39 %). However, when viewed in a disaggregated manner, it is evident that the majority of them remain in a state of negative immobility (57.85 %), meaning that a journal without a mention has continued without one (No-No), and only 10.54 % retain positive continuity (Yes-Yes). However, as this is a dynamic process that is reassessed every two years, when we look at the transition between journals that gain the mention (No-Yes) and those that lose it (Yes-No), we see that the majority gain it (17.71 %) compared to those that lose it (13.90 %).

When examining this data by field of knowledge, and focusing on the analysis of those journals that have achieved or maintained the designation over time,

it is evident that the field of Communication has the highest concentration (n=104; 50.96 %) (see Table 1).

Table 1. Changes in the listing of good publishing practices by subject area

Area	No-No	Yes-Yes	No-Yes	Yes-No	Total
Archaeology, Anthropology and Ethnology	32 (36.36 %)	15 (17.05 %)	22 (25.00 %)	19 (21.59 %)	88
Fine Arts	67 (59.82 %)	5 (4.46 %)	25 (22.32 %)	15 (13.39 %)	112
Educational Sciences	45 (45.00 %)	15 (15.00 %)	21 (21.00 %)	19 (19.00 %)	100
Communication, Information and Scientific Documentation	32 (30.77 %)	21 (20.19 %)	32 (30.77 %)	19 (18.27 %)	104

Focusing on the case study of the scientific journal *IROCAMM*, Table 2 shows that throughout its history and up to the year 2025, the journal has met the gender parity criteria on the editorial board (Women = 52.2 %; Men = 47.8 %), on the scientific committee (Women = 49.2 %; Men = 50.8 %), among those reviewing submitted articles (Women = 60.6 %; Men = 39.4 %) and in the authorship of published texts (Women = 56 %; Men = 44 %), with the exception of 2025, when there were only 8 female authors and 19 male authors among the published articles.

Table 2. History of authorship and reviewers at *IROCAMM*

Year	Published papers	Authors (men)	Authors (women)	Total authorship	International authorship	Dr.	Reviewers (men)	Reviewers (women)
2025	14	19	8	27	10	26	13	15
2024	14	11	24	35	25	35	8	20
2023	14	10	16	26	9	26	14	16
2022	14	13	11	24	18	24	13	15
2021	15	11	17	28	17	27	16	13
2020	16	14	10	24	5	24	18	14
2019	16	11	24	35	21	26	3	29
2018	7	2	6	8	2	1	2	12
TOTAL	110	91	116	207	107	189	87	134
Percentage		44.0 %	56.0 %	100 %	51.7 %	91.3 %	39.4 %	60.6 %

The problem arises because the call for evaluations offers only one option: to review authors from the last four years published by the journal. This prevents journals with a short track record, such as this one—which nevertheless maintain consistent figures over time—from being eligible for this recognition, as it depends on the gender of the authors of the texts that are received and pass the mandatory editorial and scientific review processes. It should be borne in mind that this is an emerging journal and, as such, has a low rejection rate.

Taking a positive view of these evaluation processes, which promote equality and enable a review of editorial procedures and the content published by journals, is facilitated by the fact that policies are being amended to provide author statistics broken down by gender and to promote inclusive language through their recommendations and editorial policy:

2. Use of inclusive language

IROCAMP – International Review of Communication and Marketing recommends the use of inclusive language in scientific articles that takes into account the presence and situation of women in society and that is consistent with the principle of gender equality. In this regard, it is advisable to replace the use of the generic masculine to refer to all people in the class or group, whether men or women, with generic terms, use explanatory phrases, or, when none of the above is possible, employ gender-inclusive language.

For a more concrete development of alternatives and proposals for use, it is recommended to consult the United Nations website section: [Gender-inclusive language](#).

Fig. 4. Section of the *IROCAMP* journal's website dedicated to promoting the use of inclusive language in the workplace

As well as recommending a sex/gender-disaggregated analysis across the board in the articles it receives, and including an assessment of the gender perspective in its peer reviews and evaluation reports:

3. Sex and gender in research

Research projects must avoid stereotypes and gender biases that adopt masculinity as a universal standard, exacerbate biological differences, or naturalize socially constructed differences. Likewise, they must consider the sex variable in any type of research involving people, animals, tissues, or cells; that is to say:

1. Reflect and make informed decisions about the sex composition of the samples and report the sex of the subjects investigated.
2. Analyze the differences within each of the sexes and present the results disaggregated by sex.

In this regard, it is recommended to consult the manual: [Gender in Research](#).

Fig. 5. Section of the *IROCAMP* journal's website

At the same time, the journal should review its guidelines to ensure the use of inclusive language and maintain consistency between its stated aims and its published content.

LISTA DE PERSONAS REVISORAS – AÑO 2026

H	UNIVERSIDAD	PAÍS	M	UNIVERSIDAD	PAÍS
Elpidio Del Campo	Universidad Miguel Hernández	ESPAÑA	Ileyha Dagalp	Universidad de Gotemburgo	SUECIA
Manuel Cartes	Universidad de Extremadura	ESPAÑA	Vera Ribeiro	ISCE Douro	PORTUGAL
Alfonso Cortés González	Universidad de Málaga	ESPAÑA	María Soledad Vargas Carrillo	Pontificia Universidad Católica de Valparaíso	CHILE

Fig. 6. Document published in the *IROCAMM* journal concerning reviewers. Previously, it referred only to (male) reviewers

Discussion and conclusions

One of the most significant findings is the higher number of scientific journals recognised for good editorial practices in gender equality among the lowest-ranked scientific journals. This finding reinforces the criticism that a journal's impact and/or bibliometric ranking should not be used as the sole indicator of scientific quality (Hicks et al., 2015), and shows that journals in the middle or lower quartiles can demonstrate levels of commitment to gender equality best practices comparable to those of journals in the highest quartiles.

The longitudinal analysis shows that, although most journals maintain their previous position, a significant proportion manage to incorporate references to good editorial practices in gender equality over time, adhering to this commitment and distinctive value. This pattern is particularly evident in the fields of Communication, Information and Scientific Documentation, and Education Sciences, which have traditionally been more sensitive to debates on editorial ethics, inclusive policies and the social responsibility of science.

However, the case study of the journal *IROCAMM* highlights certain tensions within the current evaluation model. Although criteria for gender parity were met across the various editorial, peer review and authorship bodies (with the exception of the first issue of 2025), the absence of any mention of this suggests that the qualitative requirements linked to the explicit incorporation of a gender perspective into editorial processes continue to represent a significant barrier for some scientific journals. This finding invites reflection on the need to accompany evaluation policies with training and guidance initiatives that facilitate the effective implementation of such practices, as well as to propose more than one scenario for requesting information and documentation in order to qualify for these distinctions, one of which should be of a longitudinal nature and cover historical development.

Overall, the results highlight the role of the Spanish Foundation for Science and Technology as a key player in promoting a more inclusive science and demonstrate that gender equality can and must be established as a central criterion of editorial excellence. Future research could extend the analysis to

other fields of knowledge or qualitatively explore the strategies adopted by journals that manage to retain the distinction over time.

Author Contributions

Author 1: Conceptualization, data curation, formal analysis, investigation, project administration, supervision, validation, visualization, and writing original draft, review & editing.

Author 2: Conceptualization, data curation, formal analysis, investigation, project administration, software, supervision, validation, visualization, and writing original draft, review & editing.

Tools of Artificial Intelligence

ChatGPT (OpenAI, 2026) was used as a supplementary tool to assist in checking the consistency of the statistical outputs without replacing the authors' final validation.

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