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Scientific education and gender: the contribution of podcasts for promoting female inclusion in science

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Abstract

Discussing gender issues within education can serve as a pathway for women to recognize themselves as protagonists in scientific fields. Thus, we reflect on how podcasts can support the development and strengthening of scientific culture, thereby contributing to the inclusion of females in science and leadership. For this purpose, we analyzed three podcasts as tools for science communication among high school students, presenting teaching practices and their contributions to building an inclusive and equitable environment in the scientific field. As a methodological approach, we adopted the Free Interpretation Analysis. The findings indicate that podcasts expand dialogue about science and foster closer connections between students and female researchers. Podcasts are valuable tools with the potential to foster reflections aimed at inclusion and female representation in science.

Keywords: Science education. Science communication. Podcast. Gender equity.

Educação científica e gênero: contribuição dos podcasts para promoção da inclusão feminina na ciência

Resumo

Discutir questões de gênero na educação pode representar um caminho para que mulheres se reconheçam como protagonistas em áreas científicas. Assim, refletimos sobre como podcasts podem favorecer a construção e o fortalecimento da cultura científica de forma a contribuir para a inclusão e o

protagonismo feminino na ciência. Para isso, analisamos três podcasts como ferramentas de comunicação científica entre estudantes do ensino médio, apresentando práticas docentes e suas contribuições para a construção de um ambiente inclusivo e equitativo no campo científico. Como abordagem metodológica, recorremos à Análise de Livre Interpretação. Constatamos que os podcasts possibilitam a ampliação do diálogo sobre ciência e a aproximação entre estudantes e pesquisadoras mulheres. Concluímos que os podcasts são recursos com potencial para promover reflexões direcionadas à inclusão e à representatividade feminina na ciência.

Palavras-chave: Educação científica. Comunicação científica. Podcast. Equidade de gênero.

Educación científica y género: la contribución de los pódcast para la promoción de la inclusión femenina en la ciencia

Resumen

Discutir cuestiones de género en el ámbito educativo puede representar un camino para que las mujeres se reconozcan como protagonistas en las áreas científicas. Ante ello, reflexionamos sobre cómo los pódcast pueden favorecer la construcción y el fortalecimiento de la cultura científica, de modo que contribuyan a la inclusión y al protagonismo femenino en la ciencia. Para ello, analizamos tres pódcast como herramientas de comunicación científica entre estudiantes de educación secundaria, presentando prácticas docentes y sus aportes a la construcción de un entorno inclusivo y equitativo en el ámbito científico. Como enfoque metodológico, recurrimos al Análisis de Libre Interpretación. Constatamos que los pódcast facilitan la ampliación del diálogo sobre la ciencia y el acercamiento entre estudiantes y mujeres investigadoras. Concluimos que los pódcast son recursos con potencial para promover reflexiones orientadas a la inclusión y representatividad femenina en la ciencia.

Palabras clave: Educación científica. Comunicación científica. Pódcast. Equidad de género.

Introduction

In the ongoing debate on strategies to promote gender equity in science, the challenges women face and the barriers that continue to hinder equitable participation and professional advancement in scientific fields are recurrently acknowledged. A diversity of initiatives has increased the presence of women in educational institutions, particularly in undergraduate and graduate programs. However, central questions persist in this discussion: why do women remain a minority in some regions of knowledge, and what factors contribute to the sharp decline in participation rates as they advance through higher levels of academic and scientific careers (Lages, 2020)?

Schiebinger (2001) argues that incorporating a gender perspective into basic education, the scientific world, and the training of young scientists is essential to deepen our understanding of the impacts of inequality, to challenge gender stereotypes, and to promote inclusive science in equitable academic environments. According to Melo and Rodrigues (2018), this can be developed through the promotion of debates and reflections on gender issues, as well as by preserving the legacy of women who made history in science. For these authors, new generations of women must find inspiration and role models in pioneering female scientists.

Promoting initiatives that foster a scientific culture inclusive of women can serve as a pathway toward breaking with androcentric perspectives in the scientific field (Simões, 2024). Reflecting on how to achieve such inclusion requires focusing on strategies that enable practical actions. In recent years, inadvances of digital information and communication technologies have significantly transformed how information is produced, distributed, and consumed. Among the formats that have gained prominence in this new landscape is the use of podcasts as audio tools for communicating scientific knowledge (Oliveira, 2022).

Available as audio resources on digital platforms, podcasts can address diverse topics across different timeframes and formats, allowing listeners to consume information in ways that fit their daily lives (Oliveira, 2022). Because of their accessibility and appeal, podcasts have been increasingly recognized as effective media for science communication (Borges, 2020; Figueira & Bevilaqua, 2022).

Dantas and Deccache-Maia (2022) examined the resurgence of audio culture, emphasizing the role of podcasts as contemporary tools for science communication. As digital audio files that require minimal storage space, podcasts function as "audio blogs" that can integrate multimedia features. The authors highlight how this format, which combines accessibility and engagement, democratizes scientific knowledge and makes it more appealing to broader audiences. Their research explored the narrative characteristics of podcasts, their effectiveness in communicating complex scientific topics, and their potential to overcome educational barriers – particularly the often excessively technical language of science.

For science communication to go beyond mere information transmission, we can draw on models such as those proposed by Brossard and Lewenstein (2009), which emphasize integrating projects that foster public understanding, exploration, and interaction with science. With the expansion of internet access and the massive use of social media, podcasts have become increasingly popular and have emerged as alternative teaching strategies for communicating science among secondary school students. Review studies highlighting the diversity of podcast applications in science education (Dantas; Deccache-Maia, 2022; Oliveira, 2022) reinforce this perspective.

Considering the potential of podcasts to enhance communication between scientists and non-specialist audiences, thereby contributing to public understanding of science, recent studies have explored their use in science education. Regarding gender issues, Simões (2024) reflects on the use of podcasts to promote women's inclusion in science, while Lages and Alencar (2020) investigated their use in science communication to expand female representation in the field. In secondary education, podcast production by female students has also emerged as a pedagogical practice aimed at discussing science produced by women (Oliveira; Gomes; Guedes; Trentin; Rosa, 2022). These practices represent forms of science communication guided by models that aim to engage the public to foster female inclusion in societal dialogues about science.

Promoting reflection and debate on gender issues within basic education provides young women with references that help them recognize themselves as protagonists in scientific fields and careers traditionally marked

by low female representation (Simões, 2024). Against this backdrop, we pose the central question that inspired this study: how can the use of podcasts foster the construction and strengthening of a scientific culture among young students, thereby contributing to female inclusion and leadership in science?

Accordingly, this study aims to analyze the contributions of three podcasts as tools for science communication among high school students – particularly girls –to inspire young women to pursue scientific fields. To this end, we discuss the potential of podcasts as educational tools, present teaching practices guided by their use, and analyze how these practices – developed within the perspective of science communication – contribute to building a more inclusive and equitable scientific environment. We assume that reflecting on this topic can promote actions that inspire female students to pursue scientific careers and disciplines.

This research adopts a qualitative methodological approach, employing the Free Interpretation Analysis (ALI) framework (Anjos; Rôças; Pereira, 2019; Anjos, 2022). By integrating theory, teaching practice, and research experiences, ALI enables a broad and sensitive reading of the studied reality, recognizing that knowledge is constructed in dialogue with social, cultural, and institutional contexts. It expands interpretive possibilities by rejecting the notion of absolute neutrality and acknowledging that every investigative process carries intentionalities, experiences, and perspectives that shape knowledge production.

The analysis of the results was based on reviewing the recordings and dissemination of the podcasts, which allowed for identifying initial insights into science communication with a focus on women's inclusion in science. Across the three podcasts, we examined the speeches and reflections of the participants in light of theoretical frameworks addressing female participation in the scientific field.

Reflections on the Androcentric Perspective in Science and Possible Paths to Gender Equity

Contemporary feminism has enabled significant progress in women's participation in science, broadening debates on equality of opportunity and

female visibility within academic and scientific spaces. Nevertheless, women's participation remains uneven, particularly in terms of disparities in access, recognition, and advancement compared with men – revealing the persistence of structural and cultural barriers within the scientific environment (Silva; Ribeiro, 2014; Roque, 2024).

The struggle for gender equity is manifest within academia, reflecting the enduring androcentric perspective that continues to shape both the formulation and management of science in Brazil. This unequal structure sustains women's exclusion and has direct consequences for scientific production (Arêas; Abreu; Nobre; Barbosa; Santana, 2023; GEMAA, 2023; Roque, 2024). The Brazilian educational landscape, however, shows an overall growth in women's presence in universities, particularly over recent decades.

Women are the majority in secondary education and in undergraduate programs, representing approximately 57% of higher education enrollments in 2015. The same trend persists in graduate education: in 2018, women accounted for 54% of students enrolled in master's and doctoral programs, while men represented 46% (Arêas; Abreu; Nobre; Barbosa; Santana, 2023).

These figures, however, can be misleading if interpreted as evidence that gender equity has been achieved – it has not. Significant disparities remain, particularly in fields such as the exact and earth sciences. Men continue to dominate leadership positions, indicating that gender equity in higher education does not automatically translate into equality in professional trajectories (Arêas; Abreu; Nobre; Barbosa; Santana, 2023). Female PhDs do not reach management and coordination roles at the same rate at which they are educated, and scientific leadership positions remain overwhelmingly occupied by men (Roque, 2024).

The "scissors effect", discussed by Benedito (2019), illustrates the progressive exclusion of women as they advance in their scientific careers, preventing them from reaching positions of leadership. Although women represent 59% of undergraduate research fellows at the beginning of their academic paths, this proportion declines sharply at higher career levels, with only 35.5% of productivity scholarships awarded to women.

This disparity reflects the "glass ceiling" effect – an invisible barrier that restricts women's access to positions of greater recognition and decision-making

in science. Despite the remarkable increase in women's participation in higher education, gender inequality remains striking at the uppermost levels of the scientific hierarchy. This reality underscores the need to overcome such imbalances to ensure equity in research funding systems and academic power structures (Benedito, 2019; Roque, 2024).

At the national level, data compiled by Arêas, Abreu, Nobre, Barbosa, and Santana (2023) indicate that women hold 58% of the scholarships granted by CAPES (the Coordination for the Improvement of Higher Education Personnel). This proportion remains similar across degree levels – 57% for master's and 54% for doctoral scholarships. However, internationally, women are a minority among CAPES international scholarship recipients (48%) and occupy fewer than half of the positions as members or coordinators of research groups. Within the National Council for Scientific and Technological Development (CNPq), only 25% of research productivity grants are awarded to women.

According to GEMAA (2023), gender inequality in postgraduate education reveals a pronounced "scissors effect", particularly in the exact sciences and engineering fields. Between 2004 and 2020, there was a significant reduction in female participation as academic careers progressed. In many disciplines, the number of women declines between the master's and doctoral levels, and this decline intensifies in the transition to stable faculty positions. Such trends show that despite women's growing access to graduate education, their persistence and advancement in academic careers continue to face structural barriers—reflecting the endurance of gender inequalities in scientific and higher education institutions.

Additional data from GEMAA (2023) show that women are more prevalent in health-related fields – traditionally associated with care and nurturing roles – such as nursing and psychology. In contrast, women's participation is substantially lower in Science, Technology, Engineering, and Mathematics (STEM) fields, including physics and astronomy. This division reflects enduring social and cultural constructions of gender that continue to shape career choices, reinforcing stereotypes that associate women with caregiving and men with technical and analytical domains.

Gender inequality in the recognition and valuation of scientific work

is also evident in the underrepresentation of women in STEM disciplines. This inequality echoes the historical phenomenon of erasing women scientists, conceptualized as the "Matilda Effect" by Rossiter (1993), which highlights the lack of recognition and visibility of women's contributions to science and society (Benedito, 2019).

Thus, the androcentric nature of science reveals a persistent gap in gender representation, perpetuating exclusionary logics that hinder the inclusion of new members – particularly women – within institutional structures (Simões, 2024). Despite progress in policies and initiatives aimed at promoting gender equity in science, the persistent absence of women in specific disciplines and at the highest levels of academic and scientific careers calls for continued debate and action (Lages, 2020). Promoting studies on gender issues is therefore essential for developing critical awareness, which enables questioning and transformation of the unequal structures that still permeate science and society (Schiebinger, 2001).

Scientific Communication to Foster a Sense of Belonging and Inclusion in Science

A wide variety of resources can be used to communicate scientific knowledge to different audiences, enabling critical and conscious engagement with information. However, beyond understanding the reach of media channels used for science communication, it is essential to reflect on what it truly means to communicate science and how this communication can be effectively achieved.

According to Castelfranchi (2010), science communication entails transforming information and knowledge into tools that expand the public's capacity for action and participation in science-related debates within democratic societies. The author argues that science communication transcends mere dissemination or transmission of knowledge; it is intrinsically linked to empowering individuals to exercise scientific citizenship – that is, to understand, question, and make informed decisions about science-related issues within their social contexts.

Science communication is also connected to the dissemination of scientific culture, which, according to Cachapuz (2016), serves as an instrument for constructing and defending citizenship. For the author, scientific culture gives meaning to information and enables the appropriation of knowledge. Therefore, when considering how to include underrepresented groups in societal discussions involving science, it becomes necessary to go beyond science popularization and dissemination – toward building and strengthening scientific citizenship itself.

The process of communicating science must be analyzed from multiple perspectives, as it involves both understanding and fostering interaction between the public and scientific knowledge. When considering the development of science communication initiatives through podcasts, this study draws on the public engagement model proposed by Brossard and Lewenstein (2009) as a framework for disseminating scientific culture. This model seeks to include non-engaged groups in discussions about science by promoting dialogue between scientists and society.

One key application of this engagement model is to create participatory mechanisms that allow citizens to contribute to conversations on scientific topics, thereby making participation more inclusive in light of social demands (Brossard; Lewenstein, 2009). For these authors, expanding public participation in debates about science requires exploring diverse communication channels and media to reach unengaged audiences and promote inclusive and democratic science communication.

In pursuit of this goal, podcasts offer strong potential to foster dialogue between scientists and the public. Conceição (2010) emphasizes the importance of aligning scientific language with educational contexts and communication media to make knowledge accessible and comprehensible to broader audiences. Such alignment helps overcome barriers to understanding and facilitates more effective integration between science and society – a role that podcasts can fulfill particularly well.

The Role of Podcasts in Promoting Women's Inclusion

Pedagogical practices were developed using podcasts as resources

to promote dialogue – within the framework of science communication – among high school students. The podcasts were part of a set of educational activities created by the science club of a public school in the interior of the state of Rio de Janeiro. These initiatives resulted from an educational process carried out as part of the doctoral research of one of the authors of this article (Simões, 2024), and were documented in a digital portfolio (Simões; Silva; Anjos; Rôças, 2024).

Three podcasts were produced to encourage reflection on gender inequalities in science, to fosterto disseminate research conducted by women scientists, fostering closer connections between researchers and students, and to inspire young people to pursue scientific careers.

In this article, we present the findings from the analysis of the first podcast and offer brief considerations regarding the second and third episodes. The recordings took place in the school's studio in an interview format, and the resulting episodes were released to the public as videocasts on the Faetec VR Channel on YouTube.

In the podcast Can girls be scientists? Always! (Figure 1), two faculty coordinators and two students from the science club interviewed a professor and researcher in the field of botany, as described in Simões (2024).

Figure 1 – Podcast F5 – Can Girls Be Scientists? Always!

Source: Simões (2024).

The interview script, developed with student participation, included questions about the interviewee's field of expertise and her research projects. In addition, the students posed questions about the researcher's personal trajectory and the barriers that women face in accessing and remaining in scientific careers.

The analysis of this podcast revealed how research on botanical knowledge was disseminated – a significant contribution toward bringing young students closer to scientific topics. The conversation with the researcher fostered reflection on the process of knowledge production, as the students came to recognize that women can produce science and that their discoveries are closely connected to their own realities. Acting as interviewers allowed the students to take an active and leading role in the conversation, while learning about research careers in botany. This experience may inspire future interest in scientific professions.

The production of the podcast encouraged dialogue between scientists and non-specialist audiences, stimulated reflection on women's participation in

science, and enabled the students to meet a young woman scientist, thereby reinforcing the sense of female representation in scientific spaces.

In the second podcast, two students involved in the school project interviewed one of the faculty coordinators of the science club. Figure 2 shows the participants in the recording studio. During the interview, the students asked questions about the club's activities and the doctoral research conducted within it. They also discussed the researcher's personal trajectory, as well as broader reflections on gender inequality and strategies for promoting women's inclusion in the scientific field.

Figure 2 – Participants during the second podcast.

Source: Research archive.

The fact that male students conducted the interview, who were able to ask questions and engage directly with a female researcher in the field of education, helped foster closer interaction between the students and the professor. It also offered insight into a doctoral research project conducted within the school context by a woman scientist at the highest level of academic training.

In a video published on the school's YouTube channel (Faetec, 2022), students shared their perceptions of scientists and the social roles played by researchers. When asked whether they knew any scientists, most of them mentioned Albert Einstein – revealing the strong influence of a well-established,

masculine, and illustrious figure in the collective scientific imagination. Regarding women scientists, most students were unable to name any, except for a single mention of Marie Curie. These findings illustrate the persistent invisibility of women in science and reflect a socially constructed androcentrism that shapes how scientific knowledge and its producers are perceived and represented.

This podcast contributed to the dissemination of scientific knowledge, promoted reflection on women's participation in science, and strengthened connections between students and the researcher. In this context, hooks (2019) emphasizes that dialogue about feminist issues is essential and should involve participants of all genders – positioning male students as allies in the struggle against the ideology of sexism.

The third podcast, titled Great Women, Great Scientists (Figure 3), featured an interview conducted by two faculty coordinators of the science club with two professors and researchers in ecology, science education, and health sciences education. The interview topics were closely related to the issues explored in the first two podcasts. Questions were designed to prompt reflection on academic careers, the dissemination of research projects, and the obstacles women face in accessing and remaining in scientific fields.

After the recording and online release, students from the science club watched the podcast together during a group activity, where they discussed the aspects of the interviews that most captured their attention. Thus, the podcast served as a pedagogical resource to foster dialogue and debate on women's inclusion in science.

Figure 3 – Participants of Podcast F5 – Great Women, Great Scientists.

Source: Research archive.

Among the topics discussed, the researchers addressed the challenges of reconciling scientific careers with motherhood. It is important to note that motherhood can represent one of the main factors significantly affecting women's academic productivity, as many reduce or temporarily interrupt their research activities, such as publishing papers, coordinating projects, and applying for research funding. Even a brief interruption can hinder professional advancement and the consolidation of women's academic careers (ABC, 2023). In contrast, fatherhood generally does not entail the same professional interruption for men, revealing a gender asymmetry in parental experiences within the scientific field.

Using podcasts as tools to promote reflection on women's participation in science enabled female students to engage with the personal and professional trajectories of the interviewed researchers. This interaction helped strengthen ties between higher education institutions and secondary schools. This proximity may encourage high school students to consider future careers in scientific fields, as they begin to see themselves represented by women researchers and recognize potential pathways and opportunities to enter these fields.

The analysis of these podcasts revealed a dynamic of scientific communication in which conversational formats were prioritized. The interviewers – representing a non-specialist audience – and the interviewees – specialists in their fields – created an interactive structure that aligns with participatory

models of science communication and engagement (Brossard; Lewenstein, 2009; Costa; Sousa; Mazocco, 2010). These models emphasize horizontal dialogue about science, employing accessible language to reach broader audiences.

Integrating scientific language into the school context helped make scientific knowledge more accessible and understandable – both for the students who participated directly in the interviews and for those who later watched the third podcast during classroom activities. This finding aligns with the perspective proposed by Conceição (2010), which highlights the importance of adapting scientific discourse to educational and communicative contexts.

In this sense, the recording and use of podcasts in the education of young students expanded public participation in incorporating gender perspectives and in advancing women's inclusion in science. This approach aligns with the public engagement model, which aims to promote scientific culture and foster a sense of belonging to the scientific community – thereby strengthening the exercise of scientific citizenship.

Final Considerations

The analysis of the podcasts demonstrated that showcasing the work of women scientists is an effective strategy for stimulating female students' interest in scientific topics. It helps bridge the gap between young women and science-related careers while reinforcing scientific citizenship among younger audiences. We observed that interactions between students and both early-career and established women researchers helped female participants feel a sense of belonging in scientific fields.

Podcasts can be considered powerful tools for disseminating and communicating scientific knowledge among researchers and students. The dialogues enabled by podcasting encourage engagement with science by fostering more critical and reflective participation from non-specialist audiences. This impact was evident among both the students who directly participated in the interviews and those who listened to or viewed the podcasts afterward – illustrating the initiative's formative and inclusive impact.

Communicating the work of women scientists through podcasts represents a meaningful strategy to motivate students and bring female audiences closer to scientific topics and careers. This practice promotes gender equity in science by making women's trajectories more visible within the scientific field and by strengthening girls' and young women's engagement in knowledge production.

Thus, the pedagogical and formative potential of podcasts as tools for reaching female audiences – and for fostering inclusion and gender representation in science – is reaffirmed.

Finally, the interpretive process of analyzing these practices through the Learning by Doing and Inquiry (ALI) approach enabled a synthesis of the knowledge produced, leading to the understanding that podcasts can indeed serve as practical tools to connect young students – especially women – with scientific fields.

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