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Challenges and advances of women in science: An extension activity developed by the PET-Chemistry of UFCG

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ABSTRACT

The presence of women in science brings a broad discussion on the subject. The diversity of this discussion is crucial to confront the paradigms that women should be exposed to casual and maternal activities, which, for a long time, have faced significant barriers that have limited their participation and recognition in scientific research. This historical inequality not only undermines women's potential, but also reduces the diversity of perspectives in science, which is critical to progress and innovation. In this context, academic extension initiatives emerge as fundamental for the contextualization and elucidation of relevant themes, with the purpose of influencing and attracting students to the domain of science. This article explores the Tutorial Education Program (PET-Chemistry) of the Federal University of Campina, which, among its attributions, is dedicated to the development of extension activities through the "Diversifica PET" project. Employing an expository and dialogued approach, the "Diversify PET" activity aims to foster scientific knowledge in the academic community through the extension entitled "Women in Science". In this context, the extension prominently highlighted the crucial role of women in the scientific environment, highlighting their contributions, advances and historical challenges. Such an approach not only underlines the importance of recognizing these trajectories, but also instigates students' reflection on the theme, enriching their understanding and instigating them to engage with science.

Keywords: Diversity, Chemical Education, Contextualization.

INTRODUCTION

The participation of women in the scientific environment has been expanding more and more, taking into account that their participation in previous centuries was scarce, as for example in the fifteenth century (Cavalli; Meglhioratti, 2018). Lúcia (2012) says that in addition to the obstacle on gender, women were also prevented from working in this environment because they were provided with empirical knowledge:

> The drastic change that occurred from the end of the fifteenth century entailed the demonization of women, especially the wise woman. That empirical knowledge, which women had mastered and practiced since ancient times, was considered suspect. It was said that given her physical and moral weakness, her limited intelligence, her lack of reasoning, her uncontrollable sexuality and her lubricity, the woman was the privileged victim (...) (P.. 375)

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What may explain this scarcity of women in the scientific field in previous centuries was the clear view that the female figure was designated only for domestic and maternal activities, lasting until the end of the nineteenth century (Soares, 2021). This century was highlighted by the training of the scientific field (Lino; Mayorga, 2016). Eren (2022) agrees that when they involve gender issues and scientific research, there are roles that are assigned and that directly impact the way scientists work in the field of science, as well as how they are seen by science. This indifference of professions continues to the present moment, as stated by Citeli (2015), who observed numerous articles on the exclusion of women in the scientific environment.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) in Brazil, together with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda, has the purpose of "Leaving no one behind":

> "The UNESCO Representation in Brazil works in a committed way with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda, whose main goal can be summarized in a commitment: "Leave no one behind". The Organization's actions and projects have a special look at issues related to the inclusion of women in society in an equal way and the fight against structural racism, as well as all forms of discrimination and in defense of diversity" (p. 3)

It is worth mentioning that such circumstances are reasons for exclusion are just some of the many obstacles that inhibit women scientists, who in fact, constantly increase their eagerness to improve professionally in science (Cardoso, 2022). In this line, we see that the trajectory of women in science has been highlighted by a lot of resilience, their manifestation has been creating a significant impact on cognitive bases in the scientific environment (Bonan et al., 2021).

Punctually in this path defined by "resistances and struggles" (Bonan et al., 2021) we observe several women who left a legacy for science. An example of what was addressed in the extension activity was manifested when we linked the discoveries of the scientist Marie Curie with the advances we have today, making a link of knowledge between the old and the new, relating her discoveries to the content on radioactivity, where the same concept was designated by the scientist (Martins, 2014).

According to the above, the work in question sought, among the responsibilities of the Tutorial Education (PET) - Chemistry program of the Federal University of Campina Grande (UFCG), to develop the extension activity entitled "DIVERSIFICA PET" on the Campus of the University itself, pointing out the importance of women in science linked to the difficulty that they had as a whole in their struggle to do science. Pereira et al., (2024) talk about the importance of such activities promoted by PETians:

> "Tutorial education groups are valuable examples of how valuing student protagonism, collective action, and concrete experiences in communities contribute significantly to society."

With the mediation of the exhibition: "women in science", the importance of women in the scientific field was highlighted, as well as the achievements of some scientists from the most varied professions, such as chemistry, biochemistry and other areas.

As Paulo Freire points out: "Teaching is not transferring knowledge, but creating the possibilities for its own production or construction" (Freire, 2002), our exhibition aimed to elucidate the work of women in science, as well as its advances. In this thought, the scientist Marie Curie, who was one of the figures worked on in our extension, said: "It is my most serious wish that some of you continue to do scientific work and maintain the ambition and determination to make a permanent contribution to science".

The objective of this work was to promote and reflect on the theme related to women in science to higher education students, in order to generate interest in them on the subject addressed and instigate them to interest in science, since they are undergraduate.

METHODOLOGY

The extension activity was promoted through the PET-Chemistry at Diversifica-PET at the José Dias dos Santos Library, located at the Federal University of Campina Grande (UFCG), at the Education and Health Center (CES), located on the campus of Cuité, Paraíba, with the target audience being undergraduate students from that campus. According to the National Council of Education (CNE), "extension activities must make up at least 10% (ten percent) of the total student curricular load of undergraduate courses, which must be part of the curricular matrix of the courses" (BRASIL, 2018, p. 3). Therefore, it is necessary with the support of the Tutorial Education Program (PET) for PETian students to promote such extension activities.

The name "Women in science" was exposed as a key theme of the exhibition, lasting 4 hours and covered a rotation of 39 students from the campus, aged 18 to 39 years old. The dissemination of the extension took place through social networks (Instagram, WhatsApp, and Facebook), through a post (Figure 1) on the PET-Chemistry profile, with the aim of expanding the projections understood as technological instruments that enable social connections to occur virtually, without disregarding the individuals who manipulate them, as Marin et al. (2021) say. An informal approach was also used (Leite, 2015).

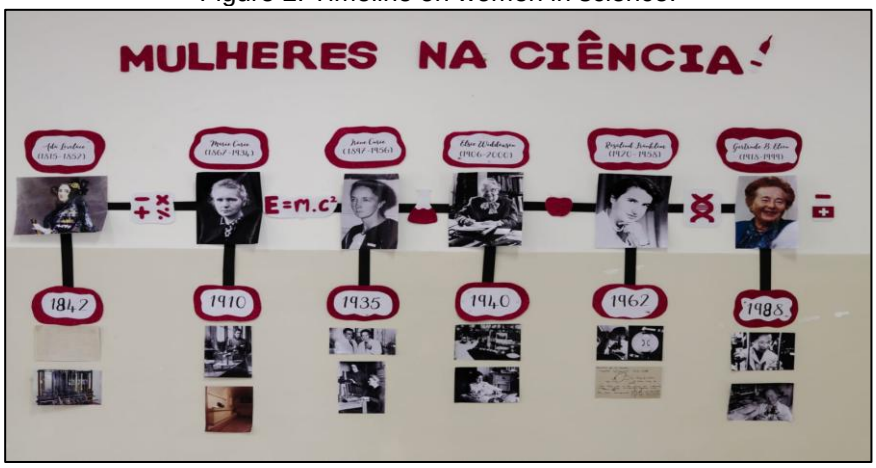
Figure 1. Dissemination of the exhibition through social media posts.

Source: Survey data (2024).

The exhibition of the activity "Women in science" had as its approach the "teaching-learning" (Link et al., 2024), causing a dialogue between the students/staff of UFCG-CES and the PETians who were carrying out the exhibition, so that knowledge was shared about the theme and the scientists who were approached during the exhibition, encouraging students to debate scientific concepts.

With this approach, our extension had the purpose of discussing and exposing the relevance that women had/has in the scientific environment, discussing their advances and contributions, so that it valued all the information that students had with them and that they could add positively to our extension, so that there was student participation. This exhibition was made through a "timeline" (Figure 2), with photos and dates displaying information about the scientists and parallel to this, the PETians exposed/explained information about the subject.

Figure 2. Timeline on women in science.



Source: Survey data (2024).

In addition to the illustration of the photos, a teaching instrument, the folder (Figure 3), was used to expose knowledge about the theme in question, in which the objective was to transmit scientific information to them. Results of a survey show that the use of folders drives students to express interest in the content worked on (Afonso, 2022), so, through them, we obtained direct communication with students. In addition, Couto and Bernardon (2014) agree that the use of folders has the promise of awakening skills in those who are reading it.

Figure 3. Educational folder distributed in the exhibition.

Source: Survey data (2024).

According to Connelly and Clandinin (1995), we can have various methods for collecting information, such as correspondence, dialogues, documents and others. In this line, the

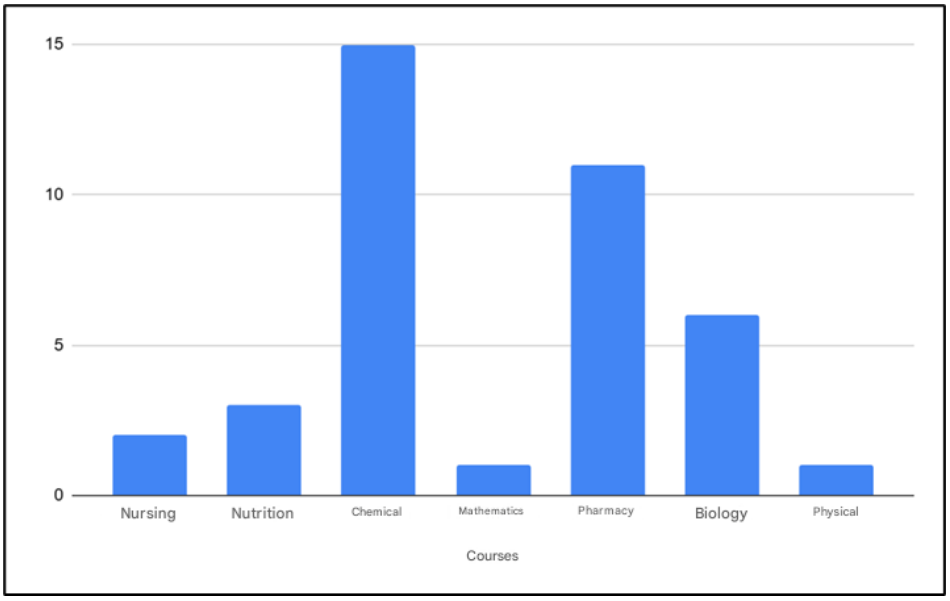
collection of information was done through an evaluative questionnaire to qualify the exposure. The authors Coutinho (2011) and Carmo and Ferreira (2008) argue that questionnaires are used with the purpose of drawing conclusions. In order to evaluate the quality of the exposure, a quantitative methodology was used. Gamboa (1995) and Richardson (1999) say that the quantitative tactic is presented by implementing quantification in the acquisition of data. The same questionnaire was answered by 39 people, with a total of ten questions, in which the aim was to examine the understanding of the people who attended the exhibition. Thus, the implementation of the questionnaire of the exhibition "Women in science" will be fundamental to improve scientific knowledge about the importance and advances arising from the theme, in order to instigate future analyses on the subject.

DEVELOPMENT

When we talk about the expansion of the theme "women in science", Bonan (2021) says that the conflicts they face are notorious. Also according to Bonan (2021), we highlight that this theme has political and social relevance. In this scenario, the debate on the presence of women in science is essential in the academic sphere. Considering the point in question, the extension: "Women in science" through the PET-Chemistry of UFCG-CES, was ready to transmit to the students of the same institution the advances and importance of women in the academic environment. From this perspective, a questionnaire was elaborated with ten (10) questions about the importance of extension, in order to know the quality of the information passed on, as well as whether the listeners have already participated in any action like this.

The initial question of the questionnaire was: "What is your area of interest in science?". This question served to observe which courses the extension covered, as well as those that were not present during it, in order to be extended in the future. The questioner had the following options: "Chemistry", "Biology", "Physics", "Mathematics", "Nutrition", "Pharmacy" and "Nursing", which correspond to the courses in force at UFCG-CES (Figure 4).

Figure 4. Participation of Students from the Education and Health Center/UFCG in the Extension by Course project.



Source: Survey data, 2024.

The data obtained from this question aimed to identify the courses whose students showed greater interest in the theme of university extension. A significant concentration of interest was observed in the Chemistry and Pharmacy courses, indicating that these courses contributed to most of the participants. This concentration suggests a greater participation and engagement of students from these areas in extension. Chemistry is an essential science that plays a key role in several areas of industry and academia (Solano et al., 2011). Its applications range from the production of new materials, medical chemistry, green and environmental chemistry, to forensic chemistry, chemical engineering, materials science and nanotechnology (Phoenix, 2007; Solano et al., 2011; Dangur et al., 2014, apud Avargil et al., 2020). It is important to emphasize that chemistry is essential for the advancement of technological and scientific innovations that drive the future development of any nation.

The question "What is your age group?" revealed that the vast majority of students in this sample, about 94.9%, are in the age group of 18 to 25 years. This data suggests that the sample is predominantly composed of young adults, possibly reflecting the typical profile of students in higher education or technical institutions. The predominance of young people in the 18-25 age group can influence the academic environment and social dynamics, with expectations and needs that are different from those of those who enter higher education at a more mature stage of life (Avargil et al., 2020). On the other hand, a small portion of the participants, corresponding to 5.1%, are in the age group of 26 to 35 years. This minority group can represent those who have chosen to return to their studies after some time, seeking new qualifications or a career change. Today, the collective of university students has taken on a more expansive form, and

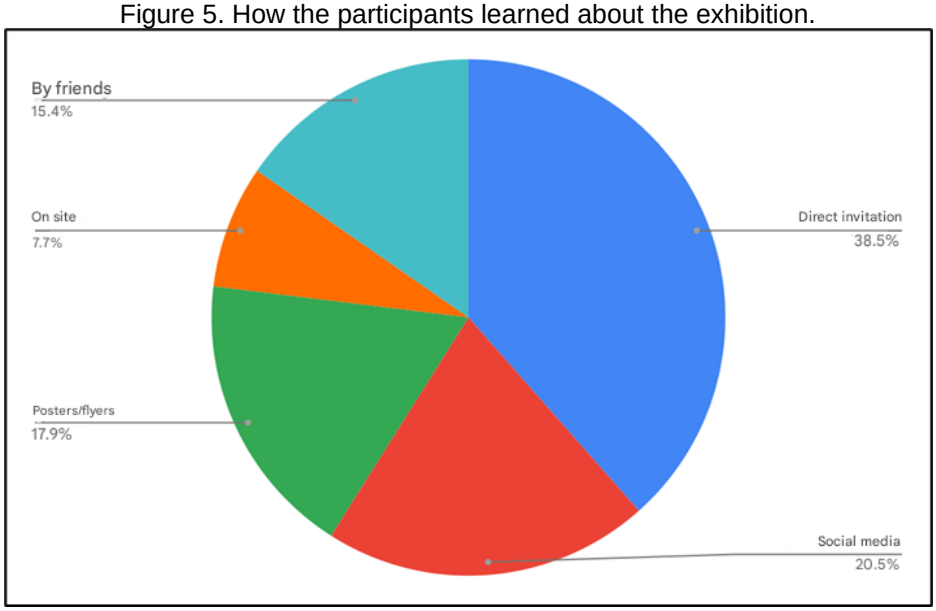
significantly more diverse in terms of age, gender, socioeconomic status, color, ethnicity, motivations, expectations, and career plans. Older people, motivated by the demands of the labor market or in search of personal fulfillment, are returning to higher education, forming the group of worker-students (Sampaio, 2014).

In the analysis of the distribution of students by sex, a clear female predominance is observed, with women representing 71.8% of the total, while men correspond to only 28.2%. This disparity suggests a lack of interest among men in what revolves around women's achievements in the scientific field and the promotion of gender equality in the scientific field. Men's lack of interest in these issues may reflect a disconnection or underestimation of the importance of these topics, which are fundamental for the advancement of equity and for the appreciation of women's contributions in science. This situation also highlights the need for greater awareness and engagement of all genders in the fight for equality and in the recognition of the victories achieved by women in the scientific field.

In several countries, women already represent a significant portion of enrollment in educational institutions, often reaching or exceeding half of the total number of students. In Brazil, this trend is even more pronounced, with women accounting for 61% of total enrollments (Inep, 2010, apud Avargil et al., 2020). This reflects a growing female presence in the educational field, evidencing a significant advance in the search for equal opportunities and greater representation in various areas of knowledge.

In Figure 5, which presents the answers to the question "How did you find out about this Extension?", a diversity of sources of information used by the participants can be observed. The most effective method of dissemination was the direct invitation, which predominated with 38.5% of the responses, indicating the importance of personal contact between extension workers and campus students to promote the event. Social media also played a significant role in outreach, reaching 20.5% of participants. According to Marin et al., (2021) Social networks can be seen as technological tools that facilitate social interaction in a virtual way, taking into account the individuals who use them (apud Romão; Júnior, 2022). This demonstrates the relevance of these platforms in the promotion and communication of academic events. In addition, posters and brochures distributed throughout the campus were responsible for attracting 17.9% of the participants, showing that the print media still has a considerable impact on the dissemination of activities, especially when strategically positioned in places of high circulation.

Figure 5. How the participants learned about the exhibition.



Source: Survey data, 2024.

Another interesting fact is that 15.4% of the participants were invited by friends who had already visited the show or were looking for company to participate in the event. This data highlights the importance of "word of mouth" and relationship networks in expanding the reach of extension initiatives. Finally, 7.7% of the participants learned about the extension at the place where the event was taking place. This small percentage indicates that some visitors discovered the activity spontaneously, without having been reached by direct invitations, social media, or the project's printed materials. This data also suggests that the visual appeal of the event at the venue also contributed to participation.

To the question "Did you find this Extension interesting?". It is observed that 100% of the participants answered yes. This result represents extremely positive feedback for the extension project, indicating that all participants found the initiative relevant.

According to (Cardoso et al., 2021) university extension projects propose a relationship of exchange of experiences between the university and society:

> Extension projects can be understood as social and scientific processes of interdisciplinary and educational interaction that allow the university and society to be involved, through the exchange of experiences (CARDOSO et al., 2021). In the same way, extension can act as three main functions: the academic one, built by theoretical and methodological knowledge; the social, giving way to the organization and construction of citizenship; and the articulator, with the development of actions (Da Silva Júnior, 2022; Bike; Tena; Séllos - Knoerr, 2019; Serrano, 2006)

According to the reflections of the thinkers mentioned, our extension activity adopted an academic approach, based on scientific knowledge and developed within the university environment. University extension has been carefully planned to encompass all courses offered

on campus, ensuring an inclusive and comprehensive approach. To further enrich the content and inspire participants, world-renowned scientists have been selected, each awarded one or more Nobel Prizes, to represent each course. By aligning the courses offered on campus with the inspiring stories of these scientists, the extension provided a unique opportunity for students to identify with their respective fields of study, while also being encouraged to reflect on the impact of their future contributions on society.

When asked about the quality of the information presented, 92.3% of the participants gave the maximum score, indicating an extremely positive evaluation. In addition, 7.7% of the participants rated the quality of the information with level 4. These results reflect a high satisfaction with the content provided during the extension. Both the oral explanation and the printed material that was made available. The vast majority of participants considered the information presented to be excellent, which is a clear sign that the objectives of transmitting knowledge effectively were achieved.

According to Gadotti (2017), university extension has the potential to initiate a transformative process in the university as a whole. Currently, the university is predominantly focused on teaching and research. However, a new paradigm for University Extension can redefine the role of the university, giving it a new purpose and meaning. The search to achieve the goals of the National Education Plan (PNE) has encouraged many to adopt an emancipatory vision of University Extension, especially as the curricularization of Extension, established by the PNE, becomes a reality.

Through the question "Have you ever participated in a lecture or event on the role of women in science?", it is observed that a significant portion, 71.8%, answered negatively, indicating that they had not participated in events or lectures on this topic. In contrast, 28.2% of the participants confirmed that they had already participated in activities related to the role of women in science.

According to the thoughts of Bonan et al., (2021, p. 6):

> By increasing the visibility of the work of women in science, we highlight aspects related to the struggles and forms of insertion in the field of health. Likewise, we seek to emphasize dialogue and the sharing of experiences with a view to enhancing other agendas and epistemologies in the production of knowledge and practices from the place and perspective of women as agents of transformation.

It is essential to highlight the contributions of women in science, as well as the struggles and difficulties they face in achieving a place of social and scientific recognition. This division of the answers reveals that, although a considerable part of the public has not yet had access to specific discussions about the contribution of women in science, there is an interest and

participation of a relevant fraction that is already engaged with these issues. This scenario underlines the need to promote more events and lectures on the role of women in science, with the aim of increasing awareness and involvement around this important topic. This event could be repeated on the commemorative day of Women and Girls in Science and on International Women's Day, both in the university environment, as well as be extended to society. Carrying out such activities can contribute to the recognition and appreciation of women's contributions in the scientific field.

When all 100% of respondents say that their awareness of the role of women in science has increased, this indicates a significant impact of raising awareness on the topic. This unanimity reflects that the extension carried out was effective in promoting a greater understanding and appreciation of the contributions of women in science. This increase in awareness not only strengthens the importance of recognizing and supporting women's participation in the scientific field, but also highlights the ongoing need to promote debate and education on gender equality.

For Bolzani (2017), in Brazil, the unequal representation of women is a scenario that is changing, manifesting a significant change in the foundation of the educational structure. According to the school census of Inep (National Institute of Educational Studies and Research Anísio Teixeira), the number of women who completed high school slightly exceeded that of men in the period from 2000 to 2012. It is ideal that we continue to incite the debate on the gender issue between men and women. The university is an excellent and suitable space for this, as it is its mission to discuss ideas and promote actions that contribute to a more egalitarian and just society (Bolzani, 2017). Extension actions directed to this theme proved to be fundamental for the discussion in the academic environment.

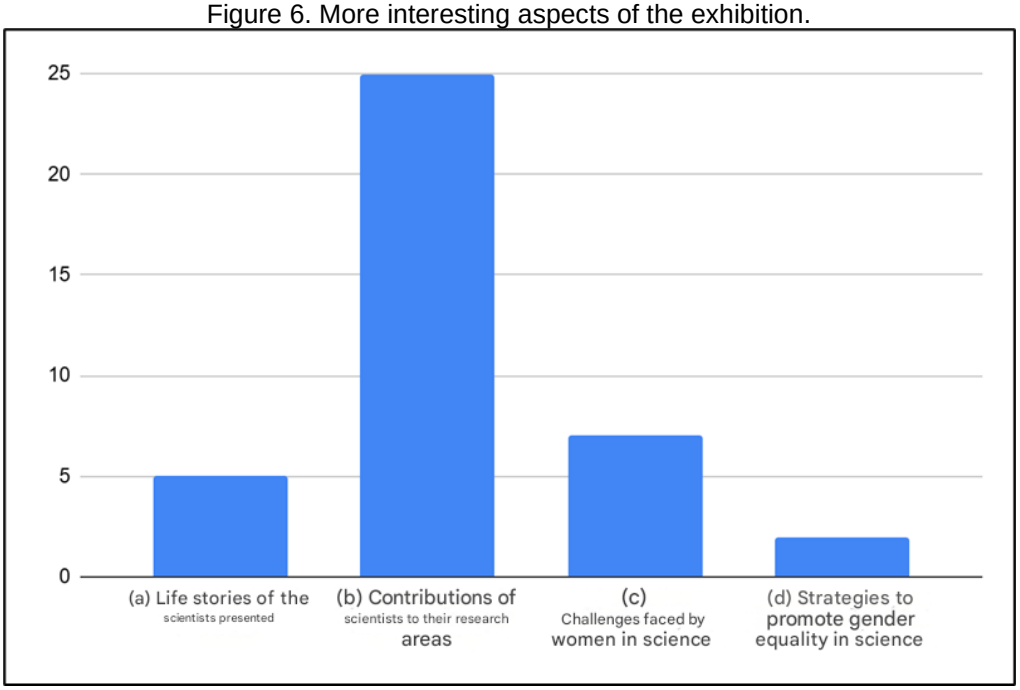
The ninth question asked: "Do you consider that events like this are essential to promote awareness about diversity and gender equality?" All participants, 100%, answered affirmatively, recognizing that events that address this theme are relevant in the academic environment. We can highlight that these initiatives are crucial to raise awareness about diversity and gender equality, especially in the field of science. This unanimity of answers shows how important it is to create spaces for dialogue and reflection on these issues in the academic environment, helping to develop more inclusive and fair thinking.

According to Felício (2010, apud Silva; Ribeiro, 2014), there is currently a notable and growing number of women working in universities and research institutions. However, it is noted that this participation has been happening in a bifurcated way, as the concentration of women is located in specific areas – what the author calls "female ghettos", such as: Psychology,

Languages, Nutrition, Social Work, Speech Therapy, Home Economics and Nursing. The author points out that these professions and specific areas tend to attract predominantly the female public. They are mostly focused on care, social support, and the promotion of well-being, both physical and emotional. This nature focused on care and social support reflects the profile of these professions, which have historically been associated with traditionally feminine attributes, such as empathy, dedication, and attention to others. Consequently, these areas continue to be preferred by women, reinforcing the perception that they have a natural vocation to care and support.

The tenth question asked: "For you, what was the most interesting aspect of the lecture?" The answers were varied and distributed as shown in Figure 6. These results show the diversity of interests of the participants, demonstrating the importance of addressing various perspectives when discussing the role of women in science.

Figure 6. More interesting aspects of the exhibition.



Source: Survey data, 2024.

Until the beginning of the twentieth century, universities were not favorable environments for the presence of women in scientific activity (Meyerson; Fletcher, 2000). However, despite restrictions and discrimination, some women have been pioneers in the scientific field, teaching at universities since the thirteenth century, mainly in Italy and Germany (Schiebinger, 2001). The fact that these women were seen as 'exceptions' highlights that the social and cultural conditions for female insertion in academic environments were extremely contrary.

FINAL CONSIDERATIONS

The trajectory of women in science has been marked by historical challenges, but also by significant advances. From initial hostility from universities to persistent underrepresentation in scientific awards and recognitions, women have faced social, cultural, and institutional barriers. However, their resilience and dedication have allowed them to conquer important spaces, becoming pioneers and agents of transformation in various areas of knowledge.

Currently, the female presence in the sciences is growing, reflecting a gradual shift towards gender equality. This transformation, while still slow, demonstrates that women not only make a vital contribution to scientific advancement, but also lead movements that promote diversity and inclusion in academia.

In conclusion, the road to gender equality in science is long and complex, but continued progress is unquestionable. Valuing women's achievements and raising awareness about gender issues are essential to building a fairer science that reflects and benefits society as a whole. It is imperative that debate on these issues continues to be encouraged, especially in academic spaces, so that we can create a more inclusive, diverse, and perspective-rich science.

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