

# INVESTIGATION ON GENDER AND LEADERSHIP IN STEM IN HIGHER EDUCATION: METHODOLOGY DESIGN

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**ABSTRACT.** Institutional actions and policies implemented by universities hold the potential to significantly impact the inclusion of women in leadership roles within STEM fields. This article describes the methodological design approved by the local ethics committee to conduct the research in Brazil, with the primary objective of understanding the degree to which discursive productions on gender affect women's career experiences and leadership paths within STEM fields in higher education. Discursive productions include structures of power such as university policies, climate, culture, and projects. It is expected that the work will provide valuable insights and support for researchers sharing similar goals and who work to reduce gender inequalities in STEM.

**KEYWORDS:** discursive productions / Brazil / gender / career experiences / leadership / STEM

## INVESTIGACIÓN SOBRE LOS DISCURSOS DE GÉNERO, STEM Y LIDERAZGO EN LOS CURSOS DE INFORMÁTICA: EL DISEÑO METODOLÓGICO

**RESUMEN.** Las acciones y políticas institucionales implementadas por las universidades tienen el potencial de impactar significativamente en la inclusión de las mujeres en roles

de liderazgo dentro de los campos STEM. Este artículo describe el diseño metodológico aprobado por el comité de ética local para llevar a cabo la investigación en Brasil, con el objetivo principal de comprender el grado en que las producciones discursivas sobre el género afectan a las experiencias profesionales y las trayectorias de liderazgo de las mujeres dentro de los campos STEM en la Educación Superior. Las producciones discursivas incluyen estructuras de poder como las políticas universitarias, el clima, la cultura y los proyectos. Se espera que el trabajo proporciona valiosas ideas y apoyo a los investigadores que comparten objetivos similares y que trabajan para reducir las desigualdades de género en STEM.

PALABRAS CLAVE: producciones discursivas / Brasil / género / experiencias profesionales / liderazgo / STEM

## INVESTIGAÇÃO EM CURSOS DE CIÊNCIA DA COMPUTAÇÃO SOBRE DISCURSO DE GÊNERO, STEM E LIDERANÇA: O DESENHO METODOLÓGICO

RESUMO. Ações e políticas institucionais implementadas por universidades têm o potencial de impactar significativamente a inclusão de mulheres em cargos de liderança nos campos STEM. Este artigo descreve o desenho metodológico aprovado pelo comitê de ética local para conduzir a pesquisa no Brasil, com o objetivo principal de compreender em que medida as produções discursivas sobre gênero afetam as experiências profissionais e trajetórias de liderança das mulheres nos campos STEM no Ensino Superior. As produções discursivas incluem estruturas de poder como políticas universitárias, clima, cultura e projetos. Espera-se que o trabalho forneça insights valiosos e apoio para pesquisadores com metas semelhantes, que buscam reduzir desigualdades de gênero em STEM.

PALAVRAS CHAVE: produções discursivas / Brasil / gênero / experiências profissionais / liderança / STEM

## 1. INTRODUCTION

There are various obstacles to the integration of women into leadership positions in the fields of Science, Technology, Engineering, and Mathematics - STEM. Among the most researched are those related to the social identity threat for women in this field (van Veelen et al., 2019); the threat of gender stereotypes in STEM (Mccullough, 2020); motivation to lead (Guzman et al., 2023); vertical segregation of women in STEM, with a decrease in the number of women along the scientific trajectory (Tavares and Parente, 2015) horizontal segregation of women, being assigned activities segmented by gender stereotypes (Olinto, 2011); and, the representative myth that men and women in STEM have different leadership styles (Jetter et al., 2013).

However, one of the obstacles that remains under-explored in research is how discursive productions about gender occurring in universities influence the leadership of women in STEM fields. Discursive productions refer to structures of power such as university policies, climate, culture, and projects (Lombardo and Meier, 2022; Krizsan and Lombardo, 2013). For example, discursive productions in higher education include university policies. Academic administration is understood to play a critical role in gender diversity efforts within universities, both in creating a university culture and in developing rules and policies that affect women's careers (Su et al., 2014).

Considering this, investigations are necessary to understand factors within university institutions that influence the engagement of careers and the pursuit of leadership positions by women, both students and faculty, in STEM fields.

Therefore, research with methodology designs that assist in gathering data on how STEM programs consider the issue of gender in their university policy propositions becomes relevant. These university policies are defined as the general guidelines that comprise the institutional development plan (PDI for "Programa de Desenvolvimento Institucional" in Portuguese), the teaching plan, and political-pedagogical projects, the programs and projects executed in the environment of higher education program, such as extension projects and public norms that manifest in the scientific field of Brazil. It is understood that attention to university governance must be exercised, being recognized as a tool for problem-solving, cost reduction, and access to the democratization of education and science (Veiga dos santos, 2016).

This need aligns with topics from the project "Latin American Open Data for gender equality policies focusing on leadership in STEM" - from the research network "Equality in Leadership for Latin America STEM - ELLAS," funded by the International Development Research Centre (IDRC, 2022; Maciel et al., 2023). In this sense, it becomes important to consider how the gender factor is produced in discourses within the university environment, with discourse being a significant practice, occurring both through oral communication or other power devices such as university policies, climate, culture,

and projects, which constitute and organize social relations (Laclau and Mouffe, 1985; Marques, 2020).

This paper presents the design of the research methodology as part of research currently being conducted for a doctorate in the Postgraduate Program in Education at the Federal University of Mato Grosso, located in Brazil, which investigates the issue: to what extent do discursive productions about gender in Higher Education influence women in STEM in their careers and in the pursuit of academic leadership positions?

This article is structured as follows. After this introduction in Section 1, the theoretical framework is presented in Section 2. Section 3 contains the description of the qualitative methodology design of the research on Academic Female Leadership in STEM. Section 4 has the final considerations, followed by the work's references.

## 2. THEORETICAL FRAMEWORK

The theoretical framework of this research is composed of feminist and gender studies (Louro, 1997) that focus on issues of educational practices that produce gender inequalities, as well as the need to formulate policies for women; the Role Congruity Theory (Eagly and Karau, 2002), which addresses the construction of gender prejudices and biases by investigating the congruity of roles expected for each gender and other social roles, such as leadership; and, the Discourse Theory developed by Laclau and Mouffe and its implications in the field of Education (Laclau and Mouffe 1985; Marques, 2020). These three frameworks will assist this study in understanding discursive productions, and will enable the interpretation of university policies, and the identification of contextual negotiations and disputes about educational actions and strategies to promote gender equity in the STEM fields.

This work comprises a descriptive study with a qualitative approach (Gil, 2022), as we seek to understand complex and contextual social issues, through participants who share their perceptions, and using different forms of data collection that will be interpreted by the theoretical framework of the research. We describe the methodology design constructed for the execution of the research "Academic Female Leadership in STEM: discourses on gender" which will be concluded in 2025. In this study, we focus on one area of STEM, which is computer science.

Specifically, this research aims to understand to what extent discursive productions about gender in Computer Science programs affect the career experiences and leadership paths of women in Higher Education. The research was submitted to the Research Ethics Committee (CEP-Humanidades) of Brazil, and obtained the Certificate of Ethical Appreciation Presentation (CAAE No. 63606622.7.0000.5690) in November 2022, authorizing its conduct in Brazilian territory. Next, the approved methodology design will be presented.

### 3. METHODOLOGY DESIGN OF THE RESEARCH ON ACADEMIC FEMALE LEADERSHIP IN STEM STEM

The context of the research is within the Higher Education system in Brazil, involving two university institutions, one public and one private, both located in the Central-West region, chosen by purposive sampling. The chosen programs were Computer Science, as it belongs to the STEM fields, and Computer Science programs are the most affected by the underrepresentation of women in leadership positions (Jaccheri et al., 2020). Data collection began in the first semester of 2023 and is expected to conclude in 2025.

As voluntary participants in the research, we have: a) women, students of Computer Science programs; b) women, faculty members of Computer Science programs; and c) a representative from the academic administration of each institution.

The research methodology will follow a strategy in six stages: 1) grey literature review of the portals of the two universities; 2) two online questionnaires; 3) focused interviews; 4) an ethico-political exercise as member checking (Spink et al., 2014); 5) data coding with the aid of MAXQDA software; and 6) data analysis. These stages are detailed below. The use of these techniques allows the collection data such as records of university policies, in addition to enabling an investigation with participatory and self-reflective perspectives by research participants, as well as member checking of the data (Creswell and Creswell, 2018).

We begin the collection data through grey literature (Paez, 2017). As this is a methodology design that considers culture, climate, and institutional context, it is necessary to record data obtained through different types of documents.

Thus, it is proposed to survey institutional documents related to gender issues at the researched Brazilian universities. And the mapping of the electronic portals of these Brazilian institutions, in order to identify university policies of gender and agendas. These surveys will take place between 2023 and 2024, composing part of the research's field-theme, and will assist in the analysis of the transversality of gender in public policies. Such analysis presupposes that the development and overcoming of gender inequalities are the responsibility of all public and social actors (Miranda, 2009).

The transversal characteristic encompasses the formulation of policies, both at the institutional and administrative levels of all public spheres, including public universities. Thus, university institutions are seen as powerful spaces for reducing gender inequities (Souza and Stolz, 2023). Among the intervention resources to combat gender inequities in university programs, there are university policies that are documented by the university, and strategies that support gender representativeness and are communicated to society through the academic institution's electronic portals. Both resources will be researched. The information collected will be saved in a document, which will

then be coded with the assistance of the MAXQDA software and categorized according to the theme of gender. It will be used as data for discursive analysis.

In addition to the grey literature review, the research invites voluntary participants to respond to two remote questionnaires to be completed via an online form. The participants include female students enrolled in Computer Science, female faculty members associated with the program, and at least one representative from the academic administration of the institutions being researched.

The first questionnaire aims to gather socio-economic data of the participants, while the second is designed to collect information on the following topics: a) the start of the academic career; b) motivation for choosing the undergraduate program; c) significant experiences during academic formation; d) individual awareness and perceptions of existing university policies, climate, culture, and projects; and e) academic engagement and leadership.

The socio-economic questionnaire seeks to understand the socio-economic characteristics of the research participants such as "Which state do you live in?" Or "Did you work while you studied?". It is important to highlight that the socio-economic questionnaire does not have mandatory questions. With the open-ended questionnaire, the purpose is to gather information that aids in understanding the perceptions of students, faculty, and academic administration regarding the theme being researched.

In the second online questionnaire, 36 questions were developed for students participating and 43 questions for faculty and academic administration. The difference is that faculty and academic administration will have seven more questions about post-academic professional experience in higher education such as the programs and training undertaken to enhance career development, experiences inside and outside the country, and the institutional contribution to their formation.

The questions for the three groups – students, faculty, and academic administration – follow a common thread. In the first eight questions, issues related to territorial displacement are addressed, which is important to understand as one of the factors of the participants' investment in their education, namely, the change of residence, state, or country for study. This aspect is seen as relevant due to research indicating the necessity of geographical migration to obtain academic formation (Pereira Cardoso et al., 2022).

Following this, seven questions are posed about motivations for choosing the undergraduate program, experiences that impacted the program, factors that hindered or contributed to academic formation, changes in choices after the beginning of the academic formation process, and changes in professional choices that were made. These questions relate to the perception of students, faculty, and academic administration about experiences in an academic formation context and their engagement in their

career. In this sense, these questions are relevant to understanding thematic affinities in shared experiences. From these affinities, it will be possible to record aspects of similarity in the face of contextual or cultural influence during the formative process.

Next, there will be seven questions about leadership strategies, such as participation in mentorships, projects related to women in STEM, and coordination of groups and/or research. Finally, fourteen questions are applied to reflect on the concept of leadership in the academic environment, and perceptions related to how to engage in the career of women in STEM, such as "What strategies do you believe are necessary for women's involvement in universities?".

With the questionnaires, the aim is not only to understand the characteristics of the participants and the perceptions of students, faculty, and academic administration about the theme but also to capture their perceptions that will assist in the elaboration of guiding questions that will act as inductive motives during the focused interviews.

Subsequently, focused interviews will be carried out in person or online via video-conference, depending on the participant's preference, they will be recorded and later transcribed (Gil, 2008). In each institution and among the research participants, three students, three faculty members, and one academic administrator representative are selected, totaling fourteen participants for the focused interviews.

The primary criterion for selection is the length of experience. In the interviews, we will use guiding questions as an inductive theme corresponding to the research objective. These questions serve as triggers for the start of the open interview and facilitate its continuity and depth (Gil, 2008), especially when it is necessary to revisit the research objective concerning women's academic leadership in STEM. Through the focused interviews, it will be possible to obtain information that allows for an understanding of gender discursive productions within the programs being researched, adding to other data collection strategies.

In a fourth stage, all participants, female students, and faculty, are invited to participate in an ethico-political exercise as members checking to understand the established relations with the concept of academic leadership in STEM (Spink et al., 2014). The workshop is structured into stages: a) introduction; b) idea association with the concept of academic leadership; c) recollections of situations where participants felt gender influenced their career development; and d) contributions to career engagement and taking on leadership positions. The decision to use this technique is based on attention to the context and relationships experienced by the study participants (Glass and Cook, 2016), in addition to being a strategy for members checking.

Finally, the data will be coded with the assistance of the MAXQDA software and categorized about the theme of gender, to demonstrate how they may infer as discursive productions. This software aids in the triangulation of data, also encourages the

researcher's critical reflexivity during analysis, and contributes to the validation of the results by researchers (Souza et al., 2010). After thematic categorization, the analysis of the data will be carried out considering the theoretical framework of the research.

#### 4. FINAL CONSIDERATIONS

It is hoped that the presented methodology design will assist researchers who seek to understand how discourses about gender are present in the university context, and to what extent discursive productions can influence the career engagement and leadership of women in STEM fields. Furthermore, through this research, we aim to collect data, especially regarding university policies that will be contribute to other initiatives related to combating gender inequalities in leadership positions in the STEM field.

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