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Do you think there is no gender inequality in Software Engineering? Perhaps you should reconsider your opinion

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Context: While researching gender inequality in software development teams, men consistently outnumber women among practitioners. Various perspectives, including gender bias and strategies to enhance diversity within development teams, have been explored by researchers in recent years. However, there is a significant gap in the existing literature, as the majority of studies focus on the perception of women practitioners, leaving the experiences of the larger demographic—men in the software development workforce—underrepresented and less examined. **Goal**: This study explores the perspectives of men regarding gender inequality within software development teams and compares their experiences in software development to those of women. **Method**: The study comprised two phases: Investigation and Confirmation. In the Investigation Phase, we distributed a survey questionnaire to gather a substantial number of responses. The subsequent Confirmation Phase aimed to validate the collected data. The Investigation phase involved 217 participants responding to a questionnaire with 27 questions. Subsequently, in the Confirmation Phase, two focus group sessions were held: one with ten Brazilian male practitioners and another with eight male practitioners working in five different European countries. The collected data was analyzed using a mixture of quantitative and qualitative techniques, incorporating graphical representations, percentages, and the grounded theory methodology. **Results**: Our results indicate that the majority of men surveyed do not perceive any sexist behavior among their team members, and they express satisfaction with their job performance. Furthermore, their primary recommendations to enhance their participation in software development projects include providing training courses and fostering improved interaction among team members. Furthermore, we did not find any substantial difference between the results we got during the Investigation and Confirmation phases. **Conclusions**: Men practitioners in software development teams encounter distinct barriers and challenges compared to their female counterparts. Moreover, they perceive that women's limited presence in software development is attributed to a perceived lack of affinity and knowledge in coding.

Keywords: *Men developers, gender bias, barriers, challenges, software development*

1 Introduction

Although there are several initiatives to increase the number of women in the field of Software Engineering (Durruthy, 2023; Brown and Parker, 2023; McIntyre, 2023; Krishna, 2023), women are still underrepresented (Canedo et al., 2020; Trinkenreich et al., 2022c,b). Men's participation dominates software development and represents 91.88% of the workforce (Overflow, 2022). Thus, women's underrepresentation still draws much attention from researchers and inclusion policy makers. Considering that men are the majority in almost all phases of software development (Feng et al., 2023; Trinkenreich et al., 2022c; Rossi and Zacchiroli, 2022), any significant action in these organizations to reduce the problems faced by women cannot be achieved without the participation, participation and contributions of men. To achieve gender equality and equal treatment in organizations, men must be encouraged to help spur women's inclusion.

The literature extensively examines women's perspectives in software development teams and academia, investigating challenges, barriers, and overcoming strategies (Bosu and Sultana, 2019; Silva et al., 2022; Kohl and Prikladnicki, 2022; Canedo et al., 2021; Rocha et al., 2023; Breukelen et al., 2023; Trinkenreich et al., 2022c). These studies usually focus on women's views about gender inequality in software engineering. In this sense, it is essential to explore how men act in situations of gender discrimination in their teams and if they recognize the challenges and barriers faced by women due to gender. Moreover, it is necessary to investigate how men can contribute to reinforcing or remediating gender inequality and uncomfortable situations faced by women coworkers. Understanding these perceptions and proposing remedial measures can contribute to a healthier and more inclusive work environment for both men and women.

In our previous work (Canedo et al., 2023), we surveyed 217 Brazilian men to investigate men's perceptions of gender inequality in software development teams, besides the challenges and barriers they face compared to the ones faced by women. Our findings revealed: 1) men practitioners are satisfied with their professional activities and perceive challenges and barriers that differ from those of female practitioners; 2) most male practitioners do not perceive any sexist behavior in the software development teams they work with, and when they perceive gender bias, they prefer to ignore it; 3) their teams also have few women in leadership positions; 4) 90%

of the men work in the software development area because they have an affinity with the area; and 5) in men perception, women do not work in this area due to a lack of affinity with the code and lack of knowledge in programming logic. Additionally, while some men do not agree with the implementation of inclusive policies, others mentioned a set of suggestions to build a better work environment. Among the most cited were: in-company training, an inclusive hiring process, diversifying teams, and improving career plans.

In this paper, we enhance our earlier research by introducing a new phase to validate the data obtained from the survey questionnaire. Our findings indicate that the majority of men who participated in our study, both in Brazil and Europe, did not observe any sexist behavior from their colleagues. The main barrier they face is communication problems with other team members and the most mentioned challenge is the lack of training. Our findings in the second phase are similar to the findings of the first one, allowing us to conclude that the barriers and challenges faced by men are different from those faced by women in the field of Software Engineering, such as, lack of trust, lack of credibility, and lack of opportunities.

The remainder of this paper is organized as follows. Section 2 presents the background and related work; section 3 introduces the step-by-step procedure for conducting the study; Section 4 presents the results found, followed by a discussion of them; Section 5 discusses the main threats to validity; and Section 6 concludes and suggests on future work.

2 Background and Related Work

Gender inequality is characterized by discriminatory differences between men and women, being a persistent and broad problem that affects millions of women and girls worldwide, preventing them from achieving their fullest potential and developing capacity (Bellotti et al., 2022). Usually, women do not have the same opportunities and rights as men. As a result, women might have difficulties in accessing opportunities for employment, education, and healthcare, which can become an obstacle to society's equitable economic and social development (Bullinaria, 2018). Gender stereotypes and division of professional positions perpetuate gender inequality (Bellotti et al., 2022). In other words, people expect women to assume specific societal roles, such as household chores and childcare, whereas men are expected to work away from home and provide for the family (Araujo et al., 2022; Canedo et al., 2022). These stereotypes limit women's choices and opportunities in the job market (Lee and Carver, 2019; Canedo et al., 2021).

In the Information and Communication Technology (ICT) field, most software engineers are men. According to the Overflow (2022), 91.88% of members of software development teams are men, against 5.17% of women and 1.67% non-binary people. Although ICT workplaces have the potential to be gender egalitarian, in which abilities and knowledge are valued independently of gender, the reality is that women are underrepresented in the area (Canedo et al., 2019). Furthermore, despite the initiatives promoted by companies to increase gender diversity and encourage their women employees to train and compete for leadership positions (Brown and Parker, 2019; Durruthy, 2018; Kohl and Prikladnicki, 2021), women still represent less than 6% of ICT practitioners (Overflow, 2022). Therefore, the workplace might be hostile and challenging for women who wish to grow professionally in this field (Canedo et al., 2021; Imtiaz et al., 2019).

Some works unveiled the challenges faced by women in ICT, such as lack of parity, feelings of not belonging to the area, social isolation, lack of recognition, higher approval rate, and code contribution when made anonymously (Bosu and Sultana, 2019; Silva et al., 2022; Kohl and Prikladnicki, 2022). Canedo et al. (2021) investigated how women software developers deal with gender inequality in an environment predominantly male. Through interviews, the authors identified some barriers faced by women, such as the lack of female representativeness and toxic culture. The study concluded that creating mentorships and a support network among women can help them face these challenges and that promoting an inclusive culture and supporting women developers in their careers is essential.

Rocha et al. (2023) also investigated women's perception in the software engineering field. They surveyed 141 women from different countries to investigate mothers' challenges and difficulties in global software development teams and universities' departments. They revealed that women face sociocultural challenges, including work-life balance issues, distrust for being mothers, bad jokes, and moral harassment. The surveyed women suggested a set of actions to reduce the challenges they face in their workplaces, such as changing culture, creating a code of conduct, and creating childcare within companies. Breukelen et al. (2023) interviewed senior women developers to identify the strategies that allow them to succeed continuously. The authors found as strategies the specialization and continuous learning of new technologies and the collective defense of themselves in sexist situations. In addition, the study highlighted the importance of organizations that offer a positive environment in addition to recognizing and encouraging women the same as men.

Trinkenreich et al. (2022c) conducted a literature review of 51 studies to provide an overview of women's participation in Open Source Software (OSS) development. The study focused on how they contribute to the projects, their motivations, challenges, and strategies to maintain an inclusive community. The authors found that about 5% of projects have women as core developers and that they created less than 5% of pull requests. However, they had similar or higher rates of pull request acceptances than men in coded and uncoded contributions. Their motivations for contributing include learning new skills, altruism, reciprocity, and kinship. The challenges they face are primarily social, such as a lack of parity and non-inclusive communication with men. The review also revealed a set of strategies to mitigate these challenges, such as promoting awareness of the presence of peers, promoting women-specific groups and events, and recognizing women's achievements (visibility).

Madsen (2021) carried out a quantitative study to explore the relationship between men's perception of gender bias, their psychological stance on gender equality, and their engagement to addressing this imbalance. The authors conducted a survey to investigate men's perceptions of gender bias, receiving 342 responses. They identified 38 items,

which they classified into a seven-factor gender bias recognition scale for men. The factors were as follows: 1. Male Privilege, 2 Disproportionate Constraints, 3. Insufficient Support, 4. Devaluation, 5. Hostility, 6. Self-silencing, and 7. Self-limiting Aspirations. The study revealed that the connection between men's perception of gender bias and both their psychological standing and engagement as men was either weak or non-existent. However, the analysis indicated that certain factors of gender bias did have a relationship with both psychological standing and men engagement. The authors suggest that developing the gender bias recognition scale for men and emphasizing the importance of psychological standing can help academia and organizations move toward achieving a greater balance of gender equality in the workplace.

In their study on gender inequality perception in Software Engineering, Wang et al. (2023) explored how male software engineers perceive gender inequality in their field. The authors interviewed 21 software engineering practitioners and proposed guidelines to stand up to gender inequality grouped into three concepts: fundamentalists, integrationists, and transformationists. These concepts are related to three aspects of an individual's social cognition: belief, attitude, and action. In the perception of men, it is not fair for organizations to define policies only for minorities, such as women and people of color, since white men also need egalitarian treatment. Additionally, the authors found that everyone in the company must understand the reasons for proposing affirmative action in support of women; otherwise, it may lead to a backlash in the behavior of male software engineers.

The authors concluded that men's comprehension of gender inequalities in software development should be taken into account when proposing solutions to this problem. Thus, open conversations with them are essential for the smooth running of affirmative action. To the best of our knowledge, Wang et al. (2023) was the only study to approach men's perception of gender inequality in software engineering. Although Wang et al. (2023) identified that this is an important and necessary topic to be investigated in the literature, there is a research gap in understanding the view of men concerning the challenges that women face and how men practitioners can support them.

3 Study Settings

In this study, we investigated men's perceptions of sexism in software engineering teams, the challenges and barriers, and how they can impact team members. The study unfolded in two distinct phases. In the initial phase, termed the Investigation Phase, our goal was to collect as much data as possible, prompting us to opt for a survey approach utilizing a questionnaire. Subsequently, we proceeded to the second phase, known as the Confirmation Phase, to validate the findings of the initial phase through a focus group. Both phases were designed to address identical research questions (RQs), which are presented as follows.

RQ.1: How do men practitioners perceive gender bias in software development teams?

RQ.2: How do men practitioners perceive the barriers and challenges related to gender issues in software development teams?

RQ.3: What is the difference between men's and women's perceptions of gender issues on software development teams?

RQ.4: How do men practitioners perceive their own careers?

RQ.5: How to build a more inclusive environment for IT practitioners?

3.1 Phase 1: Investigation - Survey Design

We have used a survey questionnaire (Kitchenham and Pfleeger, 2008a) as our research instrument to capture these perceptions. All authors of the paper were involved in designing and validating the survey questions. Two authors described the survey questions, and the others validated them. The survey questionnaire consisted of 27 questions, 23 closed questions and 4 open questions. The survey questions and complementary material is available at Zenodo.

We carried out a pilot survey with 5 practitioners who work in software development teams. The questions were refined according to the suggestions of the pilot participants. The pilot responses were discarded in the data analysis. The final set of survey questions refined after pilot feedback is available online at Zenodo.

We used the Google Forms platform [1] to create the survey. It started with the informed consent term, which presented the conditions for participating in the survey. Participation was anonymous, meaning participants were not required to disclose personal or professional information that would reveal their identities.

The survey was available from April 8th to April 19th, 2023 (11 days), and the mean time to answer was eight minutes. 221 people accessed the survey, but only 217 agreed with the terms to proceed with the survey. The survey population comprised Brazilian men practitioners working with software development in various organizations. Participants were recruited through emails, social media, and by disseminating the questionnaire on social networks.

Our survey collected qualitative and quantitative information to provide an overview of the current status related to a given (Wohlin et al., 2012) phenomenon. In the quantitative analysis, we use descriptive statistics, for example, to represent and describe the characterization data of the participants. On the other hand, qualitative analysis was performed using Grounded Theory (GT) (Stol et al., 2016). GT allows the construction of an independent and original understanding, which is suitable for collecting empirical evidence directly from the perception of industry practitioners without the bias of previous research. Therefore, GT is an appropriate method to characterize scenarios from the personal perspective of those involved in a particular discipline or activity. This is precisely the aim of the current research, which seeks to explore the perceptions of male practitioners regarding the

[1] https://www.google.com/forms

gender inequalities that exist within software development teams (Stol et al., 2016).

The coding process conducted in the application of GT is depicted in Figure 1. The example shows how the response from participant number #R6 was analyzed. In this example, this participant commented on their assumption of why women tend to assume documentation and testing positions. Based on the extracted quotes, participant #R6's response (raw data) was initially subdivided into seven codes. The bottom of the figure presents the final categories and subcategories created.

3.2 Phase 2: Confirmation - Focus Group Design

To complement the survey responses, we conducted a focus group with 10 practitioners from different Brazilian organizations (spanning 9 different states) and 8 male practitioners working in 5 different European countries: Luxembourg, Portugal, the Netherlands, Switzerland, and Germany. Practitioners were invited to participate in the focus group through our network of contacts. Regarding the European participants, we invited 2 practitioners, one from Luxembourg and another from Portugal, who then invited other colleagues from their software development teams to participate in the research. The focus group had an average duration of 1 hour and 48 minutes with Brazilian practitioners and 2 hours and 27 minutes with foreign practitioners.

We conducted two focus group sessions, and in both sessions, we used the same questionnaire employed during the Investigation Phase. This decision was made to facilitate a direct comparison of the results obtained in the previous phase as part of the Confirmation Phase. Furthermore, the focus group provided the researchers with the opportunity to respond to the participants' responses, enabling a broader and more detailed understanding of their perspectives, as well as identifying gaps that may not have been evident in the first phase.

The focus group was conducted and managed by one of the authors of the paper. Initially, an explanation was provided regarding the objectives of the study and the expectations for its execution. Subsequently, the participants were directed through targeted questions by the moderator. The moderator's role was to guide the questions and prompt participants to describe the challenges faced by men in global software development teams. The results of the focus group session were documented in the notes taken during the session and in the audio recording utilized throughout the session.

The data analysis followed several key steps. In the initial phase, termed **Collection**, the focus group session was conducted and recorded, and subsequently, we transcribed the data to enhance analysis. The transcriptions were reviewed by two authors, and any discrepancies led to a third analysis, involving listening to the recording and updating the description. Moving on to **Data Interpretation**, we identified the most frequently mentioned topics in the transcriptions and systematically organized common patterns. Finally, a **Comparison** phase involved comparing responses and opinions from focus group participants, identifying potential perspectives and similarities. The results were then described. The data analysis steps were iterative, and when necessary, we revisited previous stages, adjusting our conclusions as the analysis progressed.

4 Results and Discussion

This section presents the results and discussions of both phases of the study: (i) Investigation (Survey); and (ii) Confirmation (Focus Group), as follows.

Phase 1: Investigation - Survey. Table 1 presents an overview of the profile of the 217 survey participants. Of the 26 Brazilian states plus the Federal District, only the states of Piauí and Roraima had no representatives in the survey. On the other hand, the Federal District and the state of Espírito Santo had the large representativeness, with respectively 38.2% and 12.4% of the participants. The percentages per region follow the actual population distribution, except that the Midwest has the highest percentage instead of the lowest one, since it is the region of residency of three of the four authors and most of our closest contacts. Most participants are also young, given that more than 50% are below 37 years old, with most being between 31 to 36 years old. Still, we have a small but desired sample of around 4% participants over 55 years old. In addition, most are in a romantic relationship, predominantly married (42.9%) and the rest are committed to a partner (27.6%), although a large portion of them are single (27.2%).

Differently from what is expected considering the average age of the participants, most have less than three years of experience (51.1%), which may indicate that some started in other careers. Still, many participants have more than 15 years of experience (28.1%). In addition, around half work as programmers or developers, mostly in private companies (60%) or Federal Public Administration agencies (19%). As for the rest, 29 of them work in research and development projects (13%), 24 of them work in State-owned enterprises (11%), 17 of them work as Individual/Self-Employed Microentrepreneurs (7%), 10 of them work in State Public Administration (4%), and 5 of them work in Non-profit entities (2%).

We also investigated the characteristics of the software projects that men practitioners work on in organizations. As a result, 68% of them claimed to work on high-complexity projects, 65% of them said they were of medium complexity, and only 33% of them said they worked on low-complexity projects. Moreover, 68% of the participants work on projects with up to 10 members in the software development team, 23% have between 11 and 15 members, and 19% have more than 20 members in their team. Furthermore, 56% of the participants affirmed that the projects are developed in the JavaScript language, 46% in Java, 34% in Python, 31% in Typescript, 23% in PHP, 19% in C#, 10% in C++, 5% in Ruby on Rails and only 3% of the projects are developed in Scala. Regarding the duration of the projects, 52% of male practitioners stated that their projects lasted more than 12 months, 39% lasted between 7 and 12 months, and 35% lasted less than 6 months, as shown in Figure 2.

Related to which programming languages men practitioners have had or experience with: 77% had experience with

Figure 1. Coding process of qualitative analysis using GT

Region	#	%
North	18	8.3
Northeast	41	18.9
Southeast	52	23.9
Midwest	93	42.9
South	13	6
Age group	**#**	**%**
<=25 years old	54	24.9
26 to 30 years old	41	18.9
31 to 36 years old	50	23
37 to 42 years old	25	11.5
43 to 47 years old	22	10.1
48 to 54 years old	15	6.9
55 to 60 years old	9	4.1
>=61 years old	1	0.5
Marital Status	**#**	**%**
Committed	60	27.6
Single	59	27.2
Married	93	42.9
Divorced	5	2.3
Educational Level	**#**	**%**
Undergraduate student	53	24.4
Graduated	45	20.7
Graduated student	7	3.2
Postgraduate	31	14.3
Master student	17	7.8
Master	27	12.4
PhD student	14	6.5
PhD	23	10.6
Experience	**#**	**%**
>=3 years	46	51.9
Between 4 and 6 years	32	14.7
Between 7 and 9 years	14	6.5
Between 10 and 12 years	27	12.4
Between 13 and 15 years	16	7.4
More than 15 years	61	28.1
Role	**#**	**%**
Programmer/Developer	104	48
Project manager	44	20.4
Research professors	28	12.9
Data scientist	16	7.4
Requirements analyst	13	6
Data modeler	9	4.1
Scrum/agile master	3	1.4

Table 1. Demographics of the survey respondents (n=217).

JavaScript, 70% with Java, 56% with Python, 42% with the C language, 40% with Typescript, 37% with PHP, 29% with C++, 27% with C#, 8% with Ruby on Rails or Go, 6% with Objective C, 5% with Scala, and 3% with Lua Language. Regarding women, Trinkenreich et al. (2022c) identified that the programming languages best known by them are Java, CSS, and Scala. Still, Canedo et al. (2021) identified JavaScript and Java as the languages most known by them. Our findings revealed that men know little about CSS and

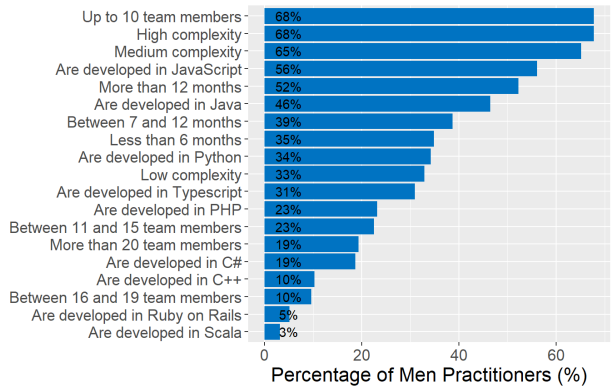

Figure 2. Participants' perceptions about the projects they worked with

Scala, two of the languages best known by women Canedo et al. (2020), but Java is unanimity for both genres.

Phase 2: Confirmation - Focus Group. As stated in Section 3.2, we conducted two focus group sessions—one with Brazilian participants and another with European practitioners. Table 2 presents the profile of the practitioners who participated in the focus group. The selected participants are acquaintances from our contact list. The first focus group section was conducted with ten Brazilians who work in nine different organizations across nine Brazilian states. Two participants work in Federal Public Administration organizations, while eight work in private companies. The majority of them are developers with knowledge of various programming languages, as shown in Table 2.

Concerning the focus group conducted with European practitioners, the participants have over 10 years of experience in the field of software development, hold a master's or doctoral degree, work in private software development organizations, serve as developers, and are proficient in programming languages such as Python, Java, JavaScript, PHP, and Scala.

4.1 RQ.1. How do men practitioners perceive gender bias in software development teams?

Phase 1: Investigation. We asked participants whether their team members interact similarly among them regardless of gender. Although other studies in the literature have identified that men do not interact with women in the same way (Canedo et al., 2021; Catolino et al., 2019; Sarmento et al., 2022; Palumbo and Manna, 2020; Garner and Van Staden, 2022; Trinkenreich et al., 2022a), our study found the opposite. The interaction among team members is equal for 74% of participants against 20% not equal, as Q9 shows in Figure 3. However, their perception may not represent what happens in reality due to the sample size.

On whether the participants observed any sexist behavior in the workplace, 34% of them did not observe it in their team. 29% have noted the lack of policies to attract more women into the organization; However, others witnessed different behaviors, as Figure 4 shows. For example, 23% of them said

Table 2. Profile of Focus Group Participants

ID	Region	Age (years old)	Marital status	Level	Experience (Years)	Role	Organization	Languages
$P_{BR}1$	DF, Brazil	Between 37–42	Married	PhD Student	Between 10–12	Project Manager	Public	JavaScript; Java; PHP
$P_{BR}2$	DF, Brazil	Between 48–54	Married	Master	More than 15 years	Project Manager	Public	Python; PHP; Delphi
$P_{BR}3$	RJ, Brazil	Between 43–47	Married	Master	More than 15 years	Project Manager	Private	JavaScript; Python; Java
$P_{BR}4$	MG, Brazil	Between 31–36	Single	Master	Between 7–9	Developer	Private	JavaScript; Java; Erlang
$P_{BR}5$	MA, Brazil	Between 26–30	Married	Master Student	Between 4–6	Developer	Private	Python; C++
$P_{BR}6$	AM, Brazil	Between 26–30	Married	Master	Between 7–9	Developer	Private	JavaScript; Python; Java
$P_{BR}7$	São Paulo	Between 26–30	Single	Master	Between 4–6	Developer	Private	Python; PHP
$P_{BR}8$	BA, Brazil	Between 43–47	Married	PhD	More than 15 years	Developer	Private	JavaScript; Java; C; PHP
$P_{BR}9$	GO, Brazil	Between 31–36	Single	Master	Between 7–9	Developer	Private	JavaScript; Python; Java;
$P_{BR}10$	PB, Brazil	61 years or older	Single	Master Student	More than 15 years	Developer	Private	Python; C++; C
$P_{EUR}1$	Luxembourg	between 48–54	Married	Master	More than 15 years	Developer	Private	Python
$P_{EUR}2$	Luxembourg	between 37–42	Single	Master	More than 15 years	Developer	Private	Java
$P_{EUR}3$	Luxembourg	between 31–36	Married	Master	More than 15 years	Developer	Private	Java
$P_{EUR}4$	Germany	between 37–42	Married	Master	Between 10–12 years	Developer	Private	JavaScript; Java
$P_{EUR}5$	Portugal	between 55–60	Married	PhD	More than 15 years	Developer	Private	JavaScript; Python
$P_{EUR}6$	Portugal	between 55–60	Married	PhD	More than 15 years	Developer	Private	JavaScript; PHP
$P_{EUR}7$	Switzerland	between 37–42	Married	Master	Between 13–15 years	Developer	Private	Java; PHP; Scala
$P_{EUR}8$	Netherlands	between 43–47	Married	Master	Between 13–15 years	Developer	Private	JavaScript

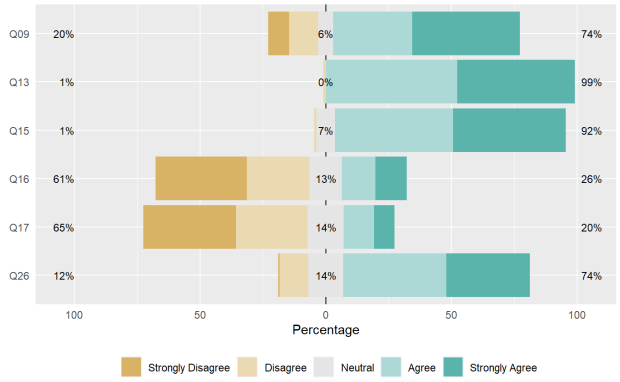

Figure 3. Participants' perceptions about whether team members interact similarly among them regardless of gender.

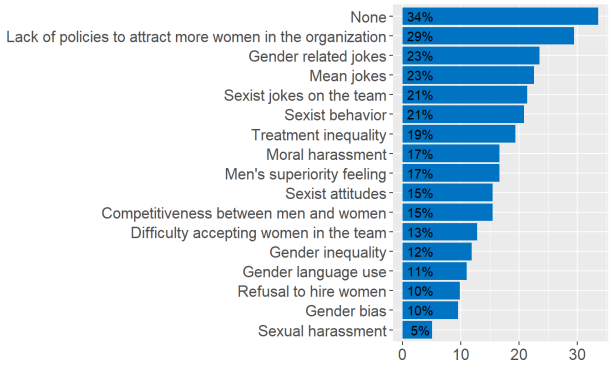

Figure 4. Participants' perceptions about whether there is sexist behavior in their team.

they had seen gender-related jokes and mean jokes; 21% of them have observed sexist jokes on the team and sexist behavior from their team members; 19% of them have already observed unequal treatment among team members; 17% observed moral harassment and feelings of superiority on the part of men; 15% have already observed sexist attitudes and competitiveness between men and women.

Canedo et al. (2021) identified that gender bias and moral harassment are the sexist behaviors most perceived by women in the Brazilian software industry. Nonetheless, the perception of men is quite different from that, as Figure 4 shows. Our findings on men's perception of the existence of sexist behavior in software development teams also differ from other studies (Imtiaz et al., 2019; Guizani et al., 2022; Trinkenreich et al., 2022b; Wang and Redmiles, 2019; Wang and Zhang, 2020).

Phase 2: Confirmation. Concerning the inquiry about whether members of the development team interacted similarly with both men and women, a consensus emerged among most participants, indicating a shared agreement on equal treatment regardless of gender. However, $P_{BR}9$ and $P_{BR}10$ mentioned that:

"...my male colleagues usually don't like to interact much with women, except for making jokes. We are afraid that some of them may not know how to perform tasks properly, so we prefer not to talk much with them during work, only during breaks when we can play and talk about non-work-related things."

"... team members don't interact much, and the other participants mentioned that the team members interact in the same way."

The majority (85%) of the European participants also stated that they had never observed any type of sexist behavior from their colleagues. Only $P_{EUR}1$ and $P_{EUR}7$ mentioned a lack of policies to attract more women into the organization. This result differs from the findings with the focus group of Brazilian practitioners, where some have observed sexist behavior in their teams, as shown in Figure 5.

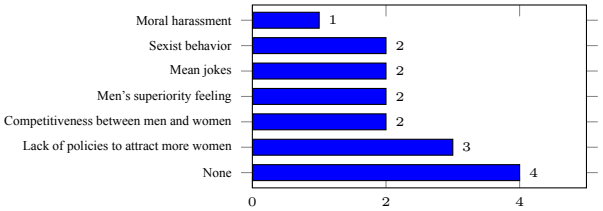

Figure 5. Brazilian practitioners' perceptions about sexist behavior in their team

RQ.1 Summary: **The survey results** indicated that male practitioners in software development teams fail to recognize or acknowledge sexist behavior, and assume that the way men interact with each other is the same as how they interact with women. Similarly, the **focus group** participants had never observed any type of sexist behavior in the development team they work in, as well as affirmed that interact with each other in the same way, regardless of gender.

4.2 RQ.2. How do men practitioners perceive the barriers and challenges related to gender issues in software development teams?

Phase 1: Investigation. Figure 6 shows the barriers that participants face or have already faced in their software development teams. In summary, 47% mentioned the lack of experience in the field; 40% reported communication problems with other team members; 28% said not feeling useful or not creating something important; 24% mentioned being treated differently by some team members; 20% said cultural differences, such as cultural aspects of each Brazilian state, e.g., accent, taste in music, among others; 20% reported difficulty in leading teams; and lastly only 17% mentioned not facing any barrier from other teammates.

On the other side, the most cited barriers identified by the women were gender bias in task allocation, difficulty in leading the team, and the lack of a leadership profile, respectively (Canedo et al., 2021). Nevertheless, *task allocation* was not even mentioned by men and the *lack of experience* was mentioned by only one of the participants in that study. Although our finding differs from other studies that investigated women's perception of the barriers they face in Software Engineering (Trinkenreich et al., 2022a,c,b; Canedo et al., 2021, 2022; Kohl and Prikladnicki, 2021; Silva et al., 2022; Garner and Van Staden, 2022; Canedo et al., 2019), we believe the studies are complementary.

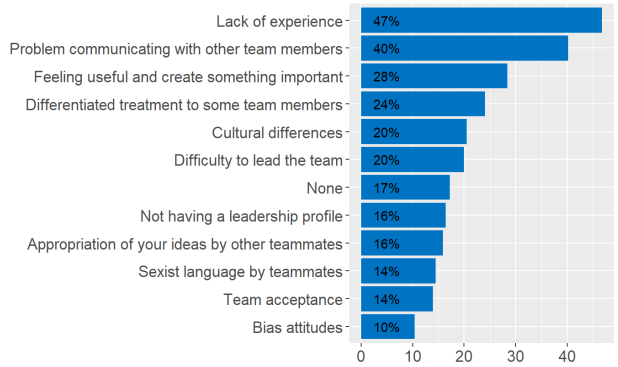

Figure 6. Participants' perceptions about the barriers they faced

Regarding the challenges (Figure 7), 47% of men practitioners reported experiencing challenges due to lack of training opportunities; 45% due to lack of knowledge; 38% due to lack of women in the organization; 27% faced a lack of trust; 25% faced lack of opportunities; 21% faced lack of attractiveness; and 20% of participants faced lack of concern from their software development team. In the women's view (Canedo et al., 2021), lack of trust was the most significant challenge faced by women. Aksekili and Stettina (2021) also identified the lack of trust as one of the challenges that women face in agile software development teams.

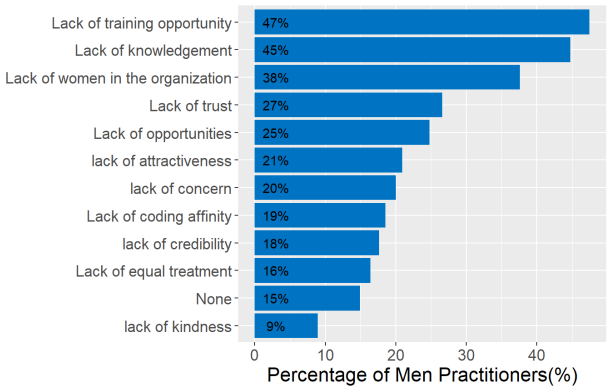

Figure 7. Participants' perceptions about the challenges they faced

Our study also showed that 65% of men practitioners did not suffer any barrier or prejudice to be accepted because they were newbies or inexperienced when they arrived at the software development team, as Q17 shows in Figure 3. Conversely, the same does not happen to women. Recent studies (Canedo et al., 2021; Trinkenreich et al., 2022a) revealed that women in software development teams have reported facing challenges in gaining acceptance from male colleagues.

Still related to gender issues, this study also investigated whether there are women in leadership positions in the companies the respondents work for. As a result, 30% of the men stated that there are no women leading software development

teams where they work for. 15% of the respondents affirmed that there is only one woman in this position. For 27%, there are between 2 and 4 women in leadership positions. For 12%, there are between 5 and 15 women. For 10%, there are more than 15; and 6% could not answer, as shown in Figure 8. Thus, 45% of respondents work in companies with no or at most one woman in a leadership position. Women are already a minority on software development teams, and women in leadership positions are even rarer.

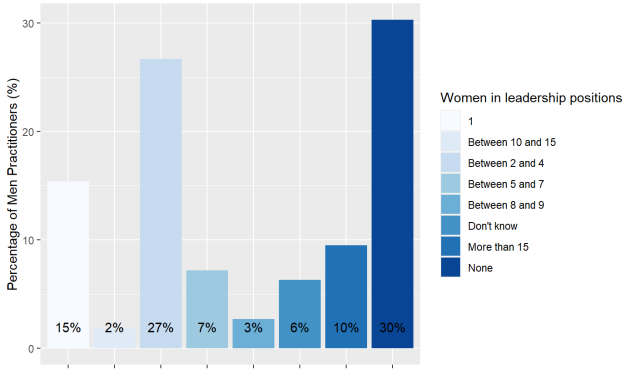

Figure 8. Women in leadership position according to participants

When there are women on the teams, they also said that they work on different projects, with high (58%), medium (56%), and low complexity (29%), and in the most diverse languages. According to the men's perceptions, the most cited languages in which women work are JavaScript (42%), Java (36%), Python (23%), Typescript (20%), C# (12%), and PHP (11%). Besides, 49% of projects have up to 10 development team members, 19% have between 11 and 15 team members, and only 12% of projects have more than 20 team members. 37% of respondents said that projects where women work last more than 12 months, 26% of them said that projects last between 7 and 12 months, and 19% said that projects where women work last less than 6 months, as shown in Figure 9.

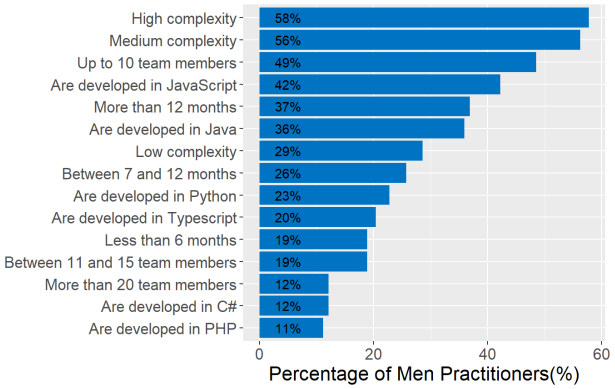

Figure 9. Participants' perceptions about the projects their women coworkers worked with

This result confirms other findings in the literature Overflow (2022); Trinkenreich et al. (2022c); Canedo et al. (2020); Catolino et al. (2019); Canedo et al. (2019) in which the authors also identified that women work on projects that are developed using different programming languages, such as JavaScript, Java, Python, Typescript and PHP.

Phase 2: Confirmation. Regarding the barriers that focus group participants face or have faced in the software development teams they work in, most Brazilians mentioned that the primary barrier was related to communication issues with other team members. This was followed by a lack of experience, difficulty leading teams, and the differential treatment of some team members, as presented in Figure 10. On the other hand, the majority of European practitioners did not mention facing any barriers. Only two of them mentioned encountering barriers related to communication with other team members. Therefore, the overall result is also quite similar to the survey questionnaire (Figure 6).

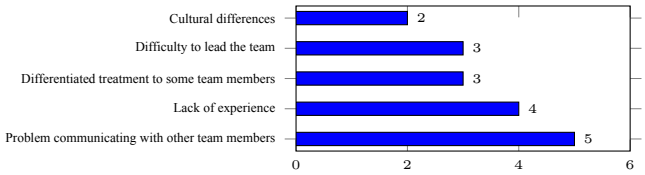

Figure 10. Brazilian practitioners' perceptions about the barriers they faced

As Figure 10 shows, the lack of training opportunities in the software development teams where Brazilian male practitioners work was the most frequently mentioned challenge by the participants, followed by a lack of recognition for their work and a shortage of women in the organization. This result aligns with the findings from the survey, where these were identified as the top 3 challenges faced by male practitioners (Figure 7). Only participant $P_{BR}9$ mentioned that men in his team make inappropriate jokes about other members of the software development team: "Men make a lot of jokes about women. We have a culture that they don't know how to program, and in fact, they really don't, and we have fun when we playfully tease them about it."

All the participants stated that when they joined their current software development team, they did not encounter any barriers or prejudice in being accepted due to being a newcomer or inexperienced. Therefore, we can infer that this outcome aligns with what we found in the survey questionnaire.

> **RQ.2 Summary**: From the **survey**, we found that men practitioners and women practitioners perceive barriers and challenges differently. In addition, men did not suffer any barriers at the beginning of their careers. An identical result was found in the **focus group** study.

4.3 RQ.3. What is the difference between men's and women's perceptions of gender issues on software development teams?

Phase 1: Investigation. We asked male practitioners if they had ever received or perceived any harassment from a colleague and how they resolved the situation. Most participants reported that they had never noticed any harassment. Less than 5% of the participants mentioned having already faced or perceived harassment. For example, respondent #R07 and #R160 said, respectively:

Table 3. Categories and subcategories from question coding

Category	Subcategory	# Cited
Technical Skills	Affinity with the area	65
	Lack of code affinity	58
	Lack of knowledge	39
	Pressure from the area	22
	Professional development	13
	Lack of experience	10
	Professional experience	8
	Complexity of the area	7
	Ease of other areas	6
	Lack of interest	5
	Difficulty in learning	5
	Lack of capacity	5
Organizational Environment	Lack of opportunities	18
	More attractive salary	8
	Hostile environment	6
	Toxic culture	6
Interpersonal and Personal Aspects	Fear	8
	Leadership profile	5
	Prejudice	4
	Gender bias in task allocation	3
	Capacity of solving problems	3
	Humane personality	4
	Impostor syndrome	3
	Empathy	3

"The person responsible for training me in a new position refused to train me and was always dismissive of me in every way, leaving a project in my charge and trying to sabotage the execution of the project. I solved it by finding a way to perform my function, ignoring this colleague, and studying and working overtime to handle the demand."

" I had to deny the demands requested by my project manager. This had negative consequences for the organization. I thought it was important to set a boundary at the beginning of the relationship. Over time, the manager realized that harassment didn't work for me, although this behavior only works with job security."

Although it is not common for men to experience harassment from bosses and co-workers, the same does not happen to women. In a recent study Canedo et al. (2021), most women reported experiencing harassment from a male colleague within their software development team. In addition, our results also confirm the findings of Trinkenreich et al. (2022c), which identified that gender bias and sexist behavior are very present in the Open Source Software community.

Additionally, we investigated why some professionals go to documentation, testing, modeling, or leadership instead of software development and if, in the men's perception, this is more frequent with men or women. We identified three categories of possible reasons: 1) Technical skills, 2) Organizational environment, and 3) Personal and interpersonal aspects. Table 3 presents the categories and subcategories identified in the data analysis. The majority of respondents cited a lack of interest or affinity for the field as the primary reason for changing areas. Of the total participants, 61% mentioned this change occurs more frequently among women, 18% mentioned it occurs equally between men and women, and only 9% reported it occurs more often among men. For example, respondent #R107 and #R199 said, respectively:

"[...] Due to the difficulty women have in writing code or the difficulty in thinking about the logic for implementing an algorithm."

"[...] Some people don't know how to program and prefer to go to these areas. Women usually don't like and don't know how to code and prefer to document. In my team, the project manager already knows this and assigns these tasks to them."

As can be seen in the male statements, some men think that women do not have the aptitude for programming tasks, which may represent discriminatory behavior on their part. Conversely, Canedo et al. (2021) investigated which activities women who participate in software development teams feel more motivated to perform, they reported that coding is the activity they like the most. However, more studies are needed to better understand this issue.

Phase 2: Confirmation. During the focus group sessions, only one Brazilian and one European participant stated that they had experienced some form of harassment from a colleague on their team. $P_{BR}4$ mentioned, "I experienced moral harassment mainly when I worked at the Ministry of Social Development (MSD). There was a team member appointed by the agency's leadership who was very difficult to deal with. Perhaps because **she was black**, she was assertive and didn't accept any suggestions for improvement, persecuting her colleagues." $P_{EUR}2$ stated, "I have experienced harassment and decided to distance myself from some team members. I avoided colleagues, and in some situations, I was even rude to some team members."

Regarding the reasons why some professionals choose roles in documentation, testing, modeling, and/or leadership instead of software development, $P_{BR}6$ mentioned that:

"... professionals who choose roles in documentation, testing, modeling, and/or leadership instead of software development do so because they do not know how to program. Typically, the women in my team opt for documenting or testing the systems developed by the team. ***The development team is entirely composed of men****."*

Regarding the reception of their contributions by other members of the software development team, all participants affirmed that their contributions were well-received. They also mentioned that they have never received or perceived any form of harassment from colleagues and do not make inappropriate jokes with their peers. Additionally, they did not encounter any barriers or prejudice in being accepted into the software development team due to being newcomers or inexperienced. Hence, we can infer that the outcomes obtained from the focus group align closely with those acquired through the survey questionnaire.

RQ.3 Summary: The findings of the **survey** showed that only a few men practitioners noticed or suffered any kind of harassment by a member of the team. Men believe that women do not have an affinity with coding and that is why they prefer to work in other areas. Along these lines, only two participants in the **focus group** study had experienced harassment on their teams. Also, some believe that women go to other areas because they do not know programming.

4.4 RQ.4. How do men practitioners perceive their own careers?

Phase 1: Investigation. We asked male practitioners which activities they felt most motivated to carry out in a software development project. As a result, 84% reported programming or development, 38% reported project management, 37% requirements elicitation, 35% software maintenance and evolution software, 34% project modeling, 27% testing, and only 14% of them reported project documentation, as shown in Figure 11. Along these lines, Canedo et al. (2021) found that both women and men reported that coding is the activity they feel most motivated to perform.

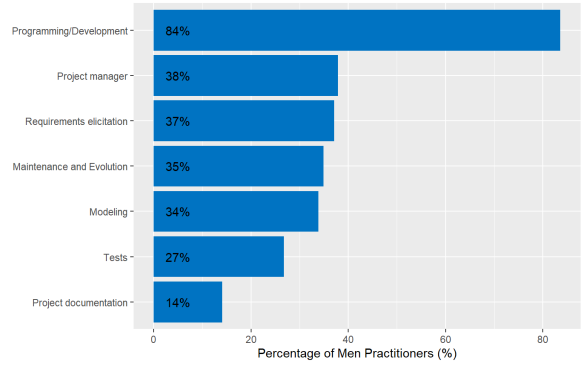

Figure 11. Activities that participants are most motivated to carry out

Regarding the reasons that led men practitioners to participate in a software development team, 90% of men reported that it was due to affinity with the software development area, 76% due to personal satisfaction, 58% due to career growth opportunities, 51% due to better salaries, 28% due to guaranteed job opportunities, and only 8% of male practitioners said it was because of the encouragement of their families. The summary of these reasons is shown in Figure 12.

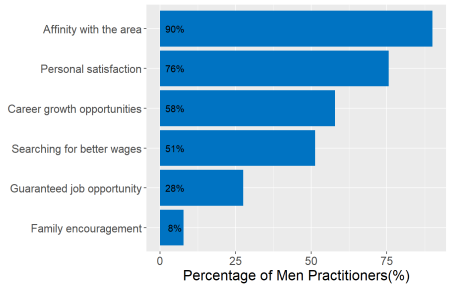

Figure 12. Reasons that led participants to join a software development team

Almost all participants (99%) confirmed that their contributions are usually well received by the other software development team members (Q13 in Figure 3). On the other hand, other studies revealed that women do **not** feel that their contributions are well received by development teams in which they work (Bosu and Sultana, 2019; Canedo et al., 2020). Also, 92% of men practitioners stated that pull requests, comments, suggestions for improvements, bug fixes, and updates are well received by the software development team (Q15 from Figure 3), contrary to what women perceive as seen in other works (Trinkenreich et al., 2022c; Terrell et al., 2017).

For 61% of respondents, both men and women do not make mean jokes with other team members. Only 26% perceive that this behavior occurs among men and women on their teams (Q16 in Figure 3). This result confirms the findings of Canedo et al. (2021) in which most women claimed to have problems related to mean and sexist jokes in the team in which they work in the Brazilian software industry.

We asked male practitioners whether their career progression met their expectations, and 74% strongly agreed or agreed, whereas 12% disagreed (Q26 in Figure 3). Nevertheless, in another study (Canedo et al., 2021), most women mentioned they do not believe they have the career development they expect. They believe that once they are women, they do not have the technical profile that software organizations value. They also reported that career progression for men is easier and faster, as stakeholders prefer men in the most critical positions and do not believe that women can repay the organization the benefit they receive from assuming a leadership position.

Regarding the level of satisfaction of male practitioners concerning their performance in their activities in software development teams, 87% of the respondents were satisfied or very satisfied, 9% were somewhat satisfied, and only 3% were dissatisfied or very dissatisfied. This result allows us to infer that men are quite satisfied with their performance in the software development teams in which they work in organizations, as shown in Figure 13 Likewise, women follow men's perception Canedo et al. (2021), since they demonstrated that are satisfied with their performance in the activities carried out in the team they work.

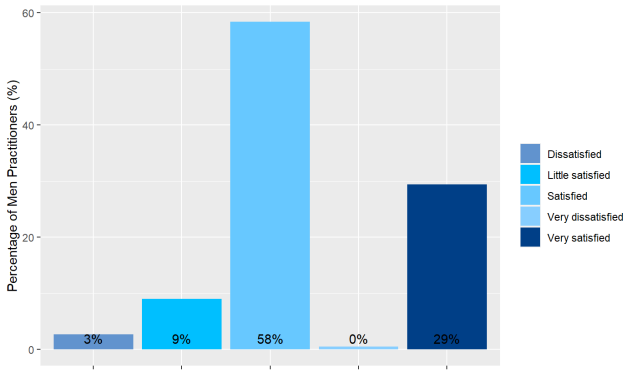

Figure 13. Level of satisfaction of participants

Phase 2: Confirmation. Concerning the factors that motivated practitioners to join software development teams, they highlighted: 1) Affinity with the field; 2) Personal satisfaction; 3) Career growth opportunities; and 4) Pursuit of better salaries. This discovery closely aligns with the outcomes

from the survey, illustrated in Figure 12. All participants in both focus groups emphasized that their contributions are usually well-received by their fellow software development team members. They asserted that they had not faced any issues with the suggestions or the code they shared, and the team consistently recognizes and praises their contributions. This result also corresponds to the findings in the survey. Participants in both focus groups expressed contentment with the progression of their careers, noting that their career trajectories meet their expectations. Furthermore, all participants reported being satisfied or very satisfied with their performance in the activities they undertake within the software development team. This observation is consistent with the survey results, as shown in Figure 13.

When we asked about the reasons why some professionals choose roles in documentation, testing, modeling, and/or leadership instead of software development, $P_{EUR}3$ stated that "In my team, people usually work in the position they would like. However, men developers may feel more confident in specific areas."

The Brazilian participants reported the absence of women in leadership roles within the software development teams of their respective organizations, while the Europeans stated that they had between 2 and 4 women in leadership positions. Male practitioners also mentioned that the activities they feel most motivated to perform in a software development project are coding activities, and suggestions to increase their participation in software development projects include the organization providing more training for team members. This result is also similar to the findings we got from the survey questionnaire.

RQ.4 Summary: For both studies, men practitioners are motivated to exercise programming activities and participate in software development teams because they have an affinity with the area. In addition, men think that their career progression meets their expectations and that team members receive their contributions well.

4.5 RQ.5. How to build a more inclusive environment for IT practitioners?

Phase 1: Investigation. The participants who were surveyed offered suggestions for creating a more inclusive work environment for IT professionals. This was an open question, so they were free to give their suggestions or not. 12.5% (25) of respondents did not answer this question, and from those who responded, ∼8% said the environment is already inclusive and did not propose improvements. In total, 177 men provided a suggestion, and from these, 18.6% (33) cited the need for **in-company training** in two ways: (i) to make employees aware of the problems faced by minority groups; and (ii) to provide professional qualification training. They suggested training focused on leaders, newly hired, and team members. Training could be delivered in workshops or informal meetings. For example, respondent #R171 and #R04 said, respectively:

> *"[...] I worked at a company that frequently had conversations about inclusion. This company also led to closer relations between employees through informal meetings."*

> *"Training for area leaders and company team managers to promote equality and respect within their teams so that they can identify and correctly deal with situations of disrespect."*

Almost ∼16% (28) of respondents suggested a more **inclusive hiring process**. However, while some of them suggested the implementation of quotas for minority groups (they cited black people, women, and LGBTQIA+), others explicitly mentioned that do not agree with quotas policies. The ones who suggested quotas affirmed that it is extremely important that there are more inclusion policies, which help speed up the breakdown of barriers to inclusion. For example, respondent #R87 stated:

> *"I believe that it is necessary to have more job openings aimed at women, LGBTQIA+, and black people. A work environment with a lot of diversity is very good."*

On the other hand, less than 3% (5) of respondents believe that **people should be hired for their technical skills** and thus there is no need for quotas. Two of them categorically stated that the companies should not implement programs only for women. For example, #R189 said:

> *"[...] they cannot commit the stupidity of hiring a professional solely and exclusively for meeting a quota or for a specific gender characteristic."*

Similarly, less than 2% (3) of respondents suggested **policies to attract both men and women**. They said that companies should have an equal policy for all company members, whether men or women. A complementary result was found in Wang et al. (2023), where they found that there are men classified as fundamentalists, who advocates male dominance in software development. They do not support a hiring plan favoring underrepresented groups.

Conversely, 14 respondents (∼8%) recommended that companies should adopt an **inclusive culture** and **inclusion and diversity policies**. They indicated that this culture and policies could come from a top-down perspective so that diversity can be treated responsibly. Hence, managers and human resources personnel should lead inclusive actions. Some of the actions mentioned were: having ambassadors of the cause; applying practical actions in the team's day-to-day, and creating clear strategies and goals. For instance, #R126 declared:

> *"(the company should) invest time and resources to develop or reformulate a culture that aligns management, development, and operation processes with more human values focused on excellence, performance, sustainability, and personal development"*

Another suggestion to build a more inclusive environment was **diversifying teams**. 11 (6.2%) respondents believe that the number of women and men in the teams could be better distributed. One respondent believes that projects that have

more women are one step ahead in the issue of empathy with users and the team itself. He also believes that women are able to better focus on solving problems and not on pointing the finger at the culprits; they can better understand when someone on the team is not well; and they are more receptive to criticism than men. Along those lines, the Cloverpop platform in a study named *Hacking Diversity With Inclusive Decision Making*[2] found that the more diverse a team, the better decisions it makes 87% of the time. Besides, companies that invest in gender equality and diversity policies show better results, including their profitability(Office, 2019).

Around 5.6% of the respondents mentioned the importance of promoting a healthier work environment. They believe that in order to foster inclusivity, the workplace should be relaxed, less formal, pleasant, and safe. They also mentioned the need for **respect and equal treatment** for all (2.3%). A place where everyone feels respected and valued. Another suggestion was to offer **flexible work hours and remote work** as a way to include more people (∼3.4% of respondents). For example, R#189 commented:

> *"If possible, and the nature of the company's activities allow, offering flexible working conditions, such as adaptable hours and remote work so that everyone can feel more comfortable and adapt better [...]"*

Ten respondents (5.6%) recommended **improving career plans and policies for progression and salary equalization**. According to them, the organization must create a career path for both men and women that allows them to progress. It is worth mentioning that among them, only one mentioned the need for a plan that includes different realities and that can analyze the organization's situation to understand its challenges and propose solutions.

Eight respondents mentioned **improving communication** as a suggestion to create a more inclusive environment and another 10 suggested actions on how this improvement could happen, totaling ∼10.2% of respondents. They proposed eight actions, which are: creating a space for exchanging experience, improving the interaction between IT and business, increasing interaction through pair programming and code review, promoting activities for collaborative knowledge, providing interdisciplinary activities, promoting collaboration between team members, and providing a common area.

They also mentioned that organizations could provide greater **support to newly hired employees** (less than 2%), with basic things like help setting up the machine environment and initial introduction of team members and their skills; they could **invest in qualification** by offering access to growth opportunities (less than 3); and **invest in trainee programs** (1.1%). Other suggestions were cited only once or twice: providing constant feedback and monitoring individual performance, offering health plans, improving business and project management, fostering the use of inclusive language, more enforcement against harassment, investing in marketing to reach more women, stopping with mean jokes, not tolerating prejudice, punishment for bad behavior, and providing complaint support tools. Table 4 presents all suggestions that received two or more citations. Compared to a study on women's perceptions (Canedo et al., 2021), the suggestions were similar between genres. However, women were more emphatic to suggest that organizations must have programs to promote gender diversity among their employees, besides conducting campaigns and lectures on the importance of having gender diversity.

[2]The Cloverpop study is available at: https://www.cloverpop.com/hacking-diversity-with-inclusive-decision-making-white-paper

Table 4. Suggestions to build a more inclusive environment

ID	Suggestions	# Cited
1	In-company training	33
2	Inclusive hiring process	28
3	Inclusive culture and inclusion and diversity policies	14
4	Diversifying teams	11
5	Healthier environment	10
6	Improving career plans /policies for progression /salary equalization	10
7	Improving communication	8
8	Flexible work hours/remote work	6
9	Hiring process by technical skills	5
10	respect and equal treatment	5
11	Investment in qualification	5
12	Supporting newly hired employees	3
13	Policies to attract both men and women	3
14	Trainee programs	2
15	Providing feedback	2
16	Improving business and project management	2
17	Investing in marketing to reach more women	2

Phase 2: Confirmation. About how to increase team members' participation in software development projects, the participants suggested the organization conduct training. In relation to suggestions for creating a more inclusive environment, it was mentioned: (1) sharing knowledge and mentoring for diversity in leadership, (2) meetings outside the workplace and creating spaces for conversations and knowledge exchange among team members, (3) establishing trainee programs to include individuals with fewer opportunities; (4) adopting inclusive hiring policies. Participants also stated that their reasons for joining software development teams were their affinity for the field and personal satisfaction. Furthermore, they expressed satisfaction with the progression of their careers and their performance in the software development teams where they work.

> **RQ.5 Summary**: While some men do not perceive the need for policies for building a more inclusive environment, many of them provided some suggestions, such as in-company training and an inclusive hiring process. Even with some men saying that do not agree with quotas policies, many said that this is an important action towards a more inclusive work environment. The results from the focus group do not show significant differences from the findings in the survey. This allows us to confirm the results we got in the Investigation Phase.

4.6 Studies' implications

The study illuminates gender bias and challenges within software development teams. Primarily, it becomes apparent that

men often overlook or deny the presence of gender bias, impeding efforts towards an inclusive work environment. Consequently, this work underscores the imperative of raising awareness and fostering dialogue around gender bias for positive change.

Furthermore, the research results revealed several instances of disparities in perceptions between male and female practitioners, as documented by Canedo et al. (2021). This highlights the need for targeted interventions. Organizations should acknowledge and tackle these differences to ensure that diversity and inclusion initiatives effectively serve all team members. Implementing training programs, sensitivity workshops, and open communication channels can facilitate this effort. Organizations stand to benefit from adopting inclusive practices and policies, fostering equity in the workplace.

Understanding practitioners' unique perspectives enables the customization of diversity initiatives to suit their needs. Specifically, as this study elucidates the differing perceptions between men and women, it provides support for organizations to implement educational policies targeting specific groups, particularly men. Addressing specific concerns fosters a more inclusive and supportive workplace culture.

Another issue illuminated by this study is the lack of confidence among men in women assuming coding positions, which can reinforce women's feelings of inadequacy in taking on such roles (Canedo et al., 2021). This underscores the importance of organizations promoting diversity across all levels and teams, as well as encouraging peer recognition and incentives irrespective of gender. Leadership, HR professionals, and team members must collaborate to challenge biases and foster a culture of inclusivity and belonging.

In summary, the study emphasizes recognizing and addressing gender bias, promoting inclusivity, and driving organizational change in software development teams. Practical guidelines emerge, such as implementing training programs, inclusive hiring processes, fostering an inclusive culture, supporting career progression, and creating a respectful work environment. These guidelines serve as a roadmap for organizations aspiring to create a more inclusive environment for IT practitioners. Future research can delve deeper into understanding factors influencing men's perceptions in software development teams and evaluate the effectiveness of diversity and inclusion initiatives. Practitioners can utilize these insights to develop tailored strategies for promoting inclusivity and addressing gender bias within their organizations.

5 Threats to Validity

As with any empirical work, this work has many limitations and threats to validity. *Content validity* is a subjective evaluation of the appropriateness of the instrument according to the target population (Kitchenham and Pfleeger, 2008b). Although the survey questionnaire has been partially used in a similar study that investigated Brazilian women's perceptions, two authors of this work created the survey, and the other two reviewed the questions to mitigate underlying threats. Moreover, before sharing the questionnaire, we conducted a pilot with five men practitioners, which resulted in some changes in the questionnaire.

The *external validity* aims to attest if the results can be generalized to other people, places, or times. Although this research has a large sample (217 men spread across Brazilian states), we cannot guarantee that it represents the whole country. Furthermore, the results may not apply to other countries due to cultural differences. Lastly, results can get outdated as time passes since cultural changes highly impact individuals' perceptions, especially when dealing with gender issues. In the *internal validity*, even though we have applied scientific rigor in the study's execution, it is inevitable that the subjectivity of the researchers would influence the result's interpretation. Given the delicate nature of some questions, even if we could attest that the analysis of the results was free from subjectivity, we cannot guarantee that our participants expressed fully honest opinions.

Another threat is that the focus groups were conducted by one of the co-authors of this article, which could influence participants' responses. To mitigate this threat, two other authors analyzed the results to ensure there were no biases regarding the practitioners' perception conclusions. Additionally, a small number of practitioners participated in the focus groups, which could pose a validity threat, although we gave preference to practitioners who claimed to perform the role of a Project Manager or Developer and had at least four years of experience in the role within software development teams.

6 Conclusions

The main result of the Investigation Phase was the significant differences in the perceptions of men and women practitioners in software development, and the Confirmation Phase ratified these findings. The responses of the participants on both research phases, showed a much more positive perception of their work and careers than the perceptions reported in previous studies of women in the field. Furthermore, the confirmation phase revealed additional details about the findings of the first phase, such as the causes behind the tendency for women to assume fewer coding positions and more documentation or similar positions.

Works focusing on women's experiences in software development found that they faced several barriers, especially at the beginning of their careers. Participants in both research phases reported experiencing fewer career difficulties and felt welcomed by their teams compared to women. Moreover, they exhibited a lower awareness of sexism than women surveyed in other studies. Some respondents even harbored sexist perceptions, such as the belief that women either dislike or lack the ability for programming activities. This disparity in perception raises important questions about the nature of gender bias and its impact on women's experiences in software development.

In both research phases, certain men continue to lack awareness of the necessity for an inclusive hiring process. Moreover, within the survey questionnaire, some oppose the idea of a hiring process explicitly tailored for women and minority groups. On the other hand, the most suggested recommendation to build an inclusive environment was in-company training. We believe that training aimed at this end

could be useful and serve to raise men's awareness about aspects of gender and inclusion.

It is clear from our results that much work needs to be done to address the issue of gender inequality in the software development industry. While progress has been made in recent years, particularly in increasing the number of women in leadership positions, there is still a long way to go to create a truly equitable workplace. As organizations seek to address this issue, they must consider the findings of this study, to create an environment that is welcoming and supportive to all people. By doing so, we can create a more diverse and inclusive industry that can better meet the challenges of the 21st century.

Although the survey questionnaire gathered data from all regions of Brazil, there were limited responses from certain states and no responses from other countries. Consequently, future studies should consider replicating the research to collect data from additional countries and more Brazilian states. Notably, during the focus group discussions, distinctions between European and Brazilian men became evident. This underscores the importance of conducting comparative studies to explore differences in the perspectives of men from various countries and regions. Variations may exist even among men residing in different Brazilian states.

We have manually checked the impact of marital status on the perception of gender bias in software development teams (RQ1), however we were not able to identify any significant relationship. We did not include this result in the paper; however, the relationship might be significant for another research study with different data. Therefore, in future work with a different database, we plan to investigate the abovementioned relationship.

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Artifact Availability

The data that support the findings of this study are openly available in Zenodo at https://doi.org/10.5281/zenodo.11154782 (Canedo et al., 2024).

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