

# Promoting Game Jams and Hackathons as more Women-inclusive Environments for Informal Learning

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**Abstract**—Hackathons and game jams are informal venues to engage STEAM (Science, Technology, Engineering, Arts, and Math) students in practical learning and nurturing interdisciplinary competencies (e.g., programming, design, communication). They also offer rich opportunities for networking and boosting the employability of participants. However, due to the not very inclusive culture created around them, these events may become hostile places for women. The low participation of women in hackathons and game jams may result in a loss of opportunity for them to improve their skills or to find jobs. Little is known about the motivations and perceptions of women participating in hackathons and game jams. We aimed at understanding (1) what are the typical gender-related problems women face in hackathons and game jams and how the perspective of men differ in regards to that problem; (2) how women perceive their motivations and their experience when participating in such events; and (3) what deters some women from participating. In this paper, we surveyed 211 participants of 8 events of this nature targeting higher education students with multidisciplinary backgrounds: 2 game jams (one of them women-focused) and 6 hackathons (one of them women-focused). Additionally, we applied a survey to hear the voice of 47 women who never attended these events to understand their lack of motivation. Through qualitative and quantitative data analysis, we compared the perspectives of men and women who participated in the studied hackathons and game jams. The qualitative data allowed us to investigate different experiences of women who reported discomfort in these events. As contributions of this paper, based on the collected data, we report different perspectives that men and women have about gender issues in these events and highlight the typical sexist behavior (bropriating, mansplaining, etc) of men participating in hackathons and game jams. Results showed that learning is the main motivation for both men and women to join these events. We also map the common reasons for women not being motivated to participate in these types of gatherings. Finally, we propose recommendations so that hackathons and game jams can increase gender equality. Our experience suggests these events, if well planned and executed, may become drivers to change attitudes and stereotypes regarding women in computing. By lowering those barriers, women can be more engaged and stimulated so they can also take advantage of more opportunities for STEAM learning in such informal settings.

**Index Terms**—Diversity, Gender, STEAM education

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## I. INTRODUCTION

In recent years, hackathons have become an increasingly popular way for software companies to generate innovative ideas, recruit new talents, and build a community of developers surrounding their platforms. The benefits for attendees include networking opportunities to meet new people, gain experience in different technologies, and improve soft skills such as communication and collaboration [1]. Hackathons are events typically lasting between 24 and 48 hours in which participants work in teams to solve a problem. Teams compete to produce the best solution that meets pre-established criteria and are assessed by a panel of judges. The winning teams are awarded in cash or other prizes. These events originated from coding marathons, but, recently the formula labelled as time-bounded collaborative has attracted a wide range of domains such as civic hackathons, code fests, jams, among others [2]. Game Jams are a similar style of event, in which developers, designers and artists gather together to develop games [3]. They are considered less competitive events compared to hackathons, although they share a similar goal to build participants' skills. Jams play an important role to support the game development ecosystem [4]. These types of challenges and competitions have an important role to engage students and lifelong learners in new technologies and skill development [5].

Traditional higher education specialized in Science, Technology, Engineering and Mathematics (STEM) is focused on building a solid foundation to form specialists in those domains. However, they do not seem to pay much attention to creative, cross-disciplinary problem-solving skills [6]. As an attempt to fill that gap of college graduates lacking in creativity and innovation there is a trend to push Arts+Design into what is being called STEAM, offering students more than high-tech skills [7]. Hackathons and Game Jams have a natural interdisciplinary approach and have become an important venue for informal learning in higher education [8] [9] [4] [10]. For STEAM, the intersection of very distinct domains can result in more enhanced student engagement and learning, helping to unlock creative thinking and innovation [11].

Stereotypes imposed on the female gender discourage the involvement and sense of belonging of women in courses related to computer science [12]. In the case of hackathons and game jam, very little is known about the motivations and perceptions of female participants in these types of events; but what has been reported so far is that these are typically non-inclusive events [13], where women are frequently victims of sexist comments, verbal abuse [14] and other forms of discrimination [9].

In this paper, we aimed at understanding (1) what are the typical gender-related problems women face in hackathons and game jams and how the perspective of men differ in regards to that problem; (2) how women perceive their motivations and their experience when participating in such events; and (3) what deters some women from participating. We present results from eight events that we organized and share insights as well as lessons learned from investigating these events concerning the viewpoint of women attendees.

The remainder of this paper is organized as follows: section II presents background and related work; section III introduces the research method; section IV details the results; section V brings discussions about those results and our recommendations; section VI concludes the article and presents future work.

## II. BACKGROUND AND RELATED WORK

### A. Informal Learning in Hackathons and Game Jams

With a primary focus to promote exploratory coding, new idea generation, and prototyping with low-risk, hackathons gained popularity in the 2000s with technology companies informally hosting such types of events [15]. Learning is one of the main motivations to participate [16] and this type of event started to be used also for interdisciplinary aspects of training [17] and for the construction of domain-specific skills [18].

Hackathons are among the different formats of activities that have been lately adopted to engage students in the resolution of critical problems, in a challenge-based approach for learning [5]. These new types of activities are indeed becoming powerful tools for education. In the context of universities, hackathons are considered an informal learning platform where students can teach and learn from their peers, allowing to establishing valuable mentorship connections among alumni [8]. Besides, students involved in these events tend to have better grades than those who did not participate. According to an exploratory study conducted by Warner and Guo [9] in the context of hackathons in universities communities, students are motivated by both social and technical reasons, in which learning occurred mostly from peers in an incidental and opportunistic way.

There are different usages of hackathons for more focused learning as well. Datathons (data-focused hackathons) [19] were reported as a way to enable students to learn and put into practice their acquired data science and analytics skills. Hackathons have also been used during a weekend in a Boot-Camp style Programming Course [20], to allow students to

consolidate their knowledge in object-oriented programming and increase their creativity and problem-solving skills. This format has also been used in a 24h hackathon that was part of the curriculum of an Internet of Things course where students created functional prototypes of connected devices as a course project [21].

Similarly to hackathons, Game Jams are a type of collaborative event that has an important role in education. The potential of game jams in promoting STEAM learning has been explicitly explored in literature [10], [22], [23]. These studies reveal significant data about the learning process provided by game jams, such as: over 50% of the participants of 2011/2012 Global Game Jam indicated that they had learned a new tool, and 96% indicated that there had been an improvement of skills. Also, researchers found that students who participated in the 2012 Global Game Jam increased the grade-point average (GPA) of their studies [10]. Beyond technical knowledge, Merilainen [22] raises the issue of soft skills learning, and says that game jams are especially good at teaching social skills, including asking for help, carrying on conversations and expressing opinions when others disagree, etc. Aurava [23] however emphasizes that a suitable format of game jam must be chosen depending on pedagogic goals and the teachers and students involved.

### B. Hackathons and Game Jams Lack Gender Diversity

Hackathons and game jams offer participants the chance to connect with local or even global communities, in cases of virtual events [24]. These events enable students and professionals in acquiring new skills and finding new career opportunities. In fact, these events are frequently used as a recruitment strategy by the computing industry. Although hackathons and game jams have been widely adopted to different contexts and flavors, concerns have been raised regarding the lack of gender diversity in these events [25]. This issue can be translated into a loss of opportunity to recruit more women, generate more diversity and gender equity in the area. The average participant profile on these types of events evokes a resemblance with the term “brogrammer”, a portmanteau of “bro” and “programmer” that attempts to represent the knowledge of coding as macho hypermasculine stereotypes [26]. These types of male stereotypes, in combination with stereotypes imposed on the female gender, discourage involvement and a sense of belonging of women in courses related to computer science and STEM in general [12]. In a study on college hackathons, the “hacker culture” or “hardcore ethos” were two of the main reasons that inhibit women from attending these events [9], while in game jams low female attendance is related to a sexist and misogynistic gaming culture [14].

Typical hackathons and game jams have not been successful to significantly increase women participation. As an attempt to change that culture, there are some efforts to change that scenario. In literature, we found reports about hackathons focusing on broader participation to diversify its audience [27] to attract more women and non-binary participants [28], [29]. Similarly, women-only game jams [30] have been organized

as a way to foster equal participation of women in the game industry. A common issue to address in such events is the so-called competence-confidence gap, which occurs mainly in women who have the competence to perform a task but do not demonstrate the necessary confidence. This phenomenon has been observed in STEM and in collaborative platforms such as GitHub [31]. There is a similar problem related to the confidence of women participants in game jams who feel less confident than men when participating in these events, as we reported in previous work [32].

Recently, companies from different domains have been organizing events in the format of hackathons to recruit new talents [33], [34]. Considering the importance of hackathons and game jams the learning process beyond classrooms and for the insertion of new professionals in their industries, we are concerned if the lack of women participating in these events may hinder the entry of women in the technology industry. Motivated by these factors, this work aims to analyze empirical data to understand why women are underrepresented in these events, and what are the reasons why women are not inspired to participate.

### III. METHOD

We applied an exploratory research approach, considering that we aim to “generate preliminary explanations on how and why a phenomenon operates as it does” [35]. The instruments used in the data collection procedure were online anonymous surveys constructed using Google Forms. The surveys mixed closed-ended and open-ended questions. We aimed at two populations to answer two different surveys, respectively: (1) women who never participated in hackathons or game jams; (2) participants (not limited to any gender identity) of hackathons and game jams. Our population sample in the first case was reached through mailing lists and social networks, reaching 47 responses. In the second case, we gathered answers from 211 participants of in-person hackathons and game jams events that we were involved in the organization (2 game jams and 6 hackathons) between 2018 and 2020.

The quantitative data collected through closed-ended questions were summarized and reported. The major data analysis was centered on the qualitative data from the open-ended questions. We used a thematic analysis approach [35] where two researchers separately generated themes which were later condensed based on an agreement about the similarities of the themes. The next subsections detail the instruments we used for women non-participants and participants, respectively.

#### A. Survey for non-participants

To understand the viewpoint of women who have never attended to hackathons or game jams, we conducted a survey aiming to explore their motivations (or lack of interest) to partake in these events. The survey consisted of two parts: (1) demographic questions: city, age, work background; (2) closed and open-ended questions focusing on women’s opinions for not joining hackathons and game jams and their feelings about men’s behavior toward women in these events and in

the respondents’ work or study environment. The close-ended questions are detailed below:

- Q1 Have you ever considered or were you interested in participating in hackathons, game jams or other events of this type?
- Q2 In any way, do you feel discouraged from going to hackathons or game jams out of insecurity about your performance?
- Q3 Do you know other women with this feeling?
- Q4 Do you believe that men and women are treated equally by their teams at these events?
- Q5 Do you believe the fact that the vast majority of participants in these events are male discourage you from participating in any way?
- Q6 How do you feel about the competitive environment of these events?

The possible answers for Q1-Q5 were Yes, No and N/A (Not applicable, No Answer), while Q6 consisted of a five-point Likert scale response format ranging from 1 (very demotivated) to 5 (very motivated). In addition to those questions, there were open-ended questions about (1) the reasons for not joining a hackathon or game jam before; (2) their opinion about a male majority being discouraging for female participation.

#### B. Survey for event participants

To understand the viewpoints of hackathon and game jam participants, we collected data from eight events that occurred between 2018 and 2020, in which the authors were involved in the organization. All events took place in the city of Recife, Brazil. Five of these events had mixed participants, and three events targeted mainly a female audience. Four events were organized in partnership with companies or public organizations, focusing on both professional and student audiences. The remaining four events were organized for university students. The events’ themes included construction, urban mobility, the electric sector, civic challenges, games, and gender issues. After the events, we asked participants to answer a brief online survey to share their experiences. The post-event survey with participants was composed of closed-ended and open-ended questions, which helped to obtain rich quantitative and qualitative data, respectively. The closed-ended questions are detailed below:

- Q1 What was your main motivation to participate?
- Q2 I believe men and women are treated equally by their work team in the technology and computing market
- Q3 I believe men and women are treated equally in their team in these events
- Q4 I believe the technology market is sexist
- Q5 I believe women are seen and/or treated differently from men in these events
- Q6 I believe women are often victims of gender bias in these events
- Q7 Level of confidence in my performance in these events

Q1 was a multiple choice question based on typical reasons for participating in hackathons [16], which also contained the

open-ended field "other" in case the respondent wanted to include an option that was not available. Q2 to Q6 used a five-point Likert scale response format ranging from 1 (totally disagree) to 5 (totally agree). Q7 had the same format, but focused on the level of confidence, ranging from 1 (very insecure) to 5 (very confident). In addition, the survey included two open-ended questions regarding situations of discrimination against women in hackathons and game jams and about receiving different treatment in these events because of being a woman. For male respondents, we asked if they have witnessed such situations.

#### IV. RESULTS

This section is organized according to the two different audiences we reached: participants (men and women) of events we were involved in the organization, and women who never participated in hackathons and game jams;

##### A. Opinions of Hackathons and Game Jams Participants

1) *Closed-ended questions:* Figure 1 presents a synthesis of eight events (six hackathons and two game jams) that we organized, which we referred to as E1 to E8. According to our results, participants consider that learning is the main motivation to attend this kind of event (Q1). The exception for women were the tech-hub female-only hackathon (E3), where networking was the main motivation, while awards was the top choice in the city hall hackathon (E5). In the case of men, the exception was challenge being their main motivation in two events: E5 and E6 (along with learning). When asked if they believe that men and women are treated equally in their work team in the computing market (Q2), women disagree with this statement, while men have a slightly more positive perception regarding gender equality. In both cases, they seem to acknowledge the challenges faced by women in their workplace. Participants seem to agree the IT workplace is sexist (Q4). As expected, women tend to strongly agree with this statement, while men are more neutral. Surprisingly, a significantly higher percentage of participants, regardless of the respondent's gender, believe that men and women are treated equally by their teams in hackathons/game jams (Q3). In particular, male participants seem very positive regarding this issue, between 81.3% (E4) and 100% (E6) of men agree with that. This result suggests these events are considered more inclusive by participants from both genders than their workplace. Similarly, women participants are more neutral, while men participants disagree that women are seen or treated differently from men in hackathons/game jams (Q5). In addition, women are neutral and men disagree regarding the statement that women are often victims of some kind of gender bias in hackathons/game jams (Q6). Finally, we did not notice very significant differences regarding the degree of confidence of women and men participants (Q7). Men are slightly more confident in terms of their performance during the events.

2) *Women's open-ended questions:* Out of 129 women, 102 (79%) provided answers for the open-ended questions. Our analysis of generated five themes: predominantly male

environment; underestimated skills; problems in team formation; no voice in the team; harassment. We detail the themes in the next paragraphs, bringing evidence from numbered participants (P), labelled for each event (E).

**Predominantly Male Environment.** Many women reported being uncomfortable in regular mixed-gender hackathons, where men are the majority of participants. This discomfort results in women feeling intimidated because of men typically having prejudice and judgment toward them as illustrated by two of the participants:

*"When the environment is dominated by men, many women feel intimidated and, consequently, insecure, with a feeling of not belonging".* (E3P20)

*"There is a judgment of competence through a first eye contact with a woman: by her way of dressing, of speaking, etc."* (E4P7).

In the case of women-focused events, such as hackathon E1, there is an opposite and positive feeling, as mentioned by participant E1P6: *"If it weren't a girl-oriented event most participants would be men and I would feel a little uncomfortable"*

**Underestimated Skills.** Some quotes from women illustrate their concerns about their technical abilities being underestimated by men. This brings more insecurity to women and prevents them from taking leading positions in teams: *"People always think that women have fewer abilities or knowledge in a particular subject and they are assigned to perform less relevant or less complex tasks"*; (E3P20)

Besides leadership, there was evidence of men putting women aside in their roles and participation in different project activities, such as design, development and even the project presentation (pitch):

*"In a hackathon that I participated in, the guy didn't believe that I was a dev just because I was a woman and gave me only the options of designer and business."* (E2P12)

*"it has already occurred me to join teams that did not even give me the opportunity to set up level design, organize the environment, or even to model or provide references relevant to the scope of the game."* (E4P1)

*"...being prevented from pitching the project or actively participating in its construction."* (E2P21)

*"[women] perform roles considered of less importance within the team."* (E3P19)

As mentioned by E7P4, a common thought by men is that *"women understand less about technology and related subjects"*. Respondents frequently reported that in these events women are seen by men as second class participants who are have limited skills and no trust from male peers. Respondent E6P2 said she heard from a man in her team things like *"'Let me do this part, it is more difficult' or 'Make the slides and I fix this bug'"* and even things that explicitly put in question her technical ability *"You know how to put the function on this button here, right?"*.

Hackathon or Game Jam / Questions	Female-focused Game Jam (E1)	University female-only hackathon (E2)	Tech hub female-only hackathon (E3)	University Game Jam (E4)	City Hall Hackathon (E5)	Electric Sector Hackathon (E6)	Urban Mobility Hackathon (E7)	Construction Sector Hackathon (E8)
Female only/priority	Yes	Yes	Yes	No	No	No	No	No
Year of realization	2020	2019	2019	2018	2019	2019	2019	2019
Number of respondents (#Women, #Men)	29	22	27	42 (10W, 32M)	23 (10W, 13M)	22 (8W, 14M)	29 (13W, 16M)	17 (10W, 7M)
Q1. Main motivation to participate (Women/Men)	Learning: 41.4%	Learning: 71.4%*	Networking: 50%**	Learning: 70% (W) Learning: 41% (M)	Award: 30% (W) Challenge: 23% (M)	Learning: 30% (W) Learning/Challenge: 23% (M)	Learning: 46% (W) Learning: 44% (M)	Learning: 30% (W) Learning: 43% (M)
Q2. I believe men and women are treated equally by their work team in the technology and computing market	Women: 6.9%	Women: 9.1%	Women: 0%	Women: 0% Men: 28.1%	Women: 0% Men: 30.8%	Women: 25% Men: 35.7%	Women: 7.7% Men: 37.5%	Women: 20% Men: 42.9%
Q3. I believe men and women are treated equally in their team in these events	Women: 27.6%	Women: 27.3%	Women: 18.6%	Women: 50% Men: 81.3%	Women: 30% Men: 92.3%	Women: 37.5% Men: 100%	Women: 53.8% Men: 93.8%	Women: 70% Men: 85.7%
Q4. I believe the technology market is sexist.	Women: 4.5	Women: 4.5	Women: 4.7	Women: 4.2 Men: 3.6	Women: 4.4 Men: 3.6	Women: 4.1 Men: 3.0	Women: 4.2 Men: 3.7	Women: 4.3 Men: 3.6
Q5. I believe women are seen and / or treated differently from men in these events	Women: 4.0	Women: 3.7	Women: 4.2	Women: 3.1 Men: 2.4	Women: 2.5 Men: 2.4	Women: 3.1 Men: 2.1	Women: 3.2 Men: 1.9	Women: 3.0 Men: 1.7
Q6. I believe women are often victims of gender bias in these events	Women: 3.7	Women: 3.6	Women: 4.2	Women: 3.1 Men: 2.3	Women: 2.6 Men: 2.3	Women: 3.0 Men: 2.0	Women: 2.9 Men: 1.9	Women: 2.9 Men: 1.6
Q7. Level of confidence in my performance in these events?	N/A	Women: 2.8*	Women: 3.7**	Women: 3.1 Men: 3.7	Women: 3.7 Men: 4.0***	Women: 3.0 Men: 3.4	Women: 3.3 Men: 3.6	Women: 3.5 Men: 3.4

\*answers available only from those who already had experience in hackathons (14 women)

\*\*answers available only from those who already had experience in hackathons (10 women)

Fig. 1. An Overview of responses from hackathons and game jams participants of the studied events (E1 to E8)

**Prejudice in team formation.** In hackathons and game jams, sometimes teams are fully or partially formed in advance. However, in situations where teams are formed during the event, such issues that frequently appeared in the participants responses encompass problems that pervade teamwork since the team formation phase, affecting roles and tasks assigned to women. The evidence of men avoiding forming groups with women was highlighted especially by female-focused hackathon participants, such as E3P4 who complained *“The preference for the formation of male teams, the lack of support for the formation of mixed or female teams already shows prejudice.”*, and E2P3 mentioning herself *“taking time to be chosen for teams”*. Game Jam participants also reported problems, in this case, related to women stereotypes, that also affect team formation: *“There is still prejudice against female developers, so in Game Jams they still frame all female participants as designers”* (E1P15). There is also explicit discrimination suffered by women who are continuously judged: *“as soon as she was chosen to be a member of his group, he told her directly that he did not want her in the team because he wanted a ‘real programmer’, as if she was not useful.”* (E3P16). This type of sexist behavior that repels women from working along with other men in mixed-gender groups stimulate the creation of groups exclusively or mostly composed by women:

*“By choice, my group was mostly female because we did not have to deal with unpleasant situations in a group with many men that would not allow us to have a voice”* (E5P5)

**No voice in the team.** One of the most frequent complaints of the survey respondents was about not having a voice in their teams. Women are frequently not heard, generating the feeling of being alone or displaced by the massive male presence: *“Women are never listened to, they are like ghosts inside the team”* (E3P4). There were also recurring statements about frequent attitudes of maninterrupting<sup>1</sup> and bropropriating<sup>2</sup>.

<sup>1</sup>Men frequently interrupting a woman and blocking her right to express ideas [36]

<sup>2</sup>A man appropriating a woman’s idea as if it was his own [36]

The occurrence of both behaviors is illustrated by the quote from this participant: *“They are interrupted when talking and their ideas either end up being discarded or appropriated by a man”* (E8P10).

Some respondents explicitly complained about mansplain-ing<sup>3</sup>, such as E2P9 *“Not having credibility or suffering mansplaining”*, and others referred to it implicitly, as in this combination of maninterrupting and mansplaining: *“A friend told that when she participated in a hackathon she was barely able to express her opinions, which were already cut off, or the man tried to explain her own work area to her”* (E3P4).

**Harassment.** Some women reported moral and even sexual harassment situations in the events we have been studying. When explaining that women are often victims of some sort of gender bias in hackathons, participant E2P18 mentioned that *“moral or sexual harassment, being left out, when exposing an idea or even having the idea stolen”*. This is always a concern when men many times approach women disguised as someone trying to help or to network with but with other intentions, as reported by participants E3P11 and E4P7, respectively:

*“...even sexual harassment, being seen as someone more than an event colleague with people approaching for issues other than networking or work”*

*“Sometimes there are ulterior motives for a man approaching.”*

Other respondents reported events of sexual harassment that happened to colleagues or that they have heard about, as mentioned by E2P14 *“someone was hitting on a friend of mine in a hackathon”* and by E3P23 *“I’ve heard of women who could not be heard in their groups being the only woman in it and I’ve heard cases of sexual harassment.”*

3) **Men’s open-ended questions:** Among 82 men in the survey, 23 (28%) answered having witnessed prejudice toward women in hackathons or game jams. There were answers just mentioning *“I never witnessed any problem”* and others trying to justify or find excuses for prejudice: *“In fact, prejudice is*

<sup>3</sup>It refers to a man explaining something to a woman without regard to the fact that she knows more than him about that topic [37]

more a reflex of the market, where few women are present in roles as developers”. However, there were men aware of the problems women face in these events. The three themes from our analysis were: **underestimated skills**, **no voice in the team** and **harassment**, respectively illustrated by the quotes below, which are identified by event occurrence (E1-E8):

*“Doubts regarding their competence or knowledge”* (E4)

*“Women are silenced by mansplaining, maninterrupting, etc. It is striking how men do not actively listen to women or allow them to defend their ideas in hackathons”* (E7)

*“I have already witnessed harassment. A guy talking dirty nonstop to girls he didn’t even know, he was kicked out of the hackathon ”* (E5)

#### B. The voice of women who never participated

The survey sent to women who never participated in hackathons and game jams shows that 20 (42.6%) of the 47 respondents have between 19 and 26 years, and 41 (87%) come from a STEM background. The results of the closed-ended questions, presented in Figure 2, illustrate that there was a significant number of respondents that feel motivated to participate (Q1), since 38 (80.9%) women responded they have the interest to participate in these types of events. Also, 44 (93.6%) respondents explained they feel discouraged from attending due to insecurity regarding their performance (Q2). When asked if they knew other women with the same insecurity (Q3), 23 (48.9%) answered they do, 4 (8.5%) did not and 20 (42.6%) had no answer for that. Another interesting result from the survey shows that 40 (85%) of the respondents believe women and men are not treated equally by their peers during these events (Q4). This result opposes the opinion found in the set of answers from actual participants who consider that attendees, despite their gender, receive equal treatment by their teams. The survey showed that 33 (70.2%) respondents are reluctant to participate in hackathons because these events have predominantly male participants (Q5). Our involvement in hosting different types of events confirms that some participants are excited by the thrill of competition, although 20 (42.6%) women answered they feel unmotivated/very unmotivated because of the competitive environment of events (Q6).

When analyzing the open-ended questions, the most common reasons observed for women not participating in events like hackathons were: **low confidence about technical abilities**; **predominantly male environment**; **event format**; **lack of opportunities to participate**. We also grouped the **motivations to participate** as the last category detailed below. The quotes illustrating evidence from responses will refer to participants as P1 to P47.

**Low confidence about technical abilities.** Many respondents mentioned low confidence or insecurity about their technical skills not being enough to contribute to the project. Typical statements on the responses were similar to P38: *“I don’t know if I have enough knowledge to participate”*., while other

statements were more explicit about not being at the same level of knowledge of the teamwork, such as P31 and P24:

*“Even though I know they are places for learning, I don’t think I will be able to contribute to the group because I don’t have the necessary technical knowledge”* (P31)

*“I am afraid that I will not be able to do a good job in a short time and that I will be judged by other people if the result of the work is not cool.”* (P24)

Respondent P25 compared herself to a hypothetical male peer: *“...it seems to me that just having a man on the team, he will develop better than me, or that I won’t even have the space to learn or show what I know.”*. Such feeling of insecurity is related to the next code, which involves women being outnumbered by men in these environments.

**Predominantly male environment.** The low female presence in hackathons and game jams is a factor that discourages other women to join, who fear to experience judgment or insecurity due to such massive male presence. The statement written by P7 covers many of those aspects: *“Men always form teams first, because there are always more men. It is a struggle for a man to join a team where the majority are women (this is still rare). I already feel the disapproving look of men at events related to technology ... as if you always have to prove that you know a lot more”*. This feeling of insecurity that results from being a minority is reinforced by the statement of P36: *“...feeling of insecurity for being the only girl in the environment, who in many moments is not encouraged to speak”*. There was also a complaint of men invading space that is intended for women: *“Even in hackathons that are aimed at women, men insist on participating”* (P43).

**Event format.** Hackathons and game jams follow an intensive format where participation usually spans over a weekend. The survey participant P15 complained about that fact and also about the competitive environment: *“I do not like the fact that the event literally takes all day during the weekend... I don’t like the atmosphere of racing against the clock to deliver the solution in a hurry, I don’t like the competitive*

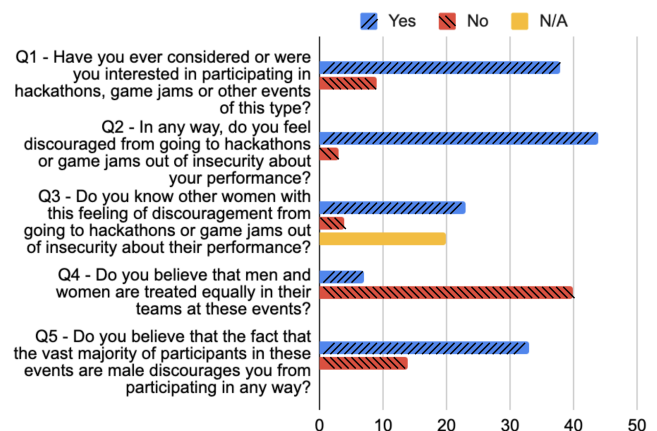


Fig. 2. Responses of women who never participated.



atmosphere”. Many times these events happen non-stop with some participants sleeping over the place (or not sleeping at all), which was an aspect not appreciated by some respondents who had concerns about their own safety such as P45: “*Issues like spending the night at the place or coming back home late and alone*”. Some respondents did not appreciate these particularities of the event format, especially women with children: “... *not having to spend the night away from home because of my children*” (P44). The bad food and the lack of equipment were pointed out by P43: “*discouraging factors are food (usually it’s sandwich) and taking your own notebook (not everyone is in a position to have a dev’s notebook)*”.

**Lack of opportunities to participate.** Many respondents never had an opportunity to join hackathons or game jams. There were some answers showing that some women, such as P22, who is a 31-35 year holding a Computer Science degree, was unaware of what these types of event are: “... *I never had any incentive [to participate] from other women, because I don’t even know what it is about, ... or how I participate, I think we need more promotion and encouragement from other women so those unaware of it, like me, could be curious and get help to enter this world.*” (P22). There were other cases of respondents mentioning just the lack of opportunities or never being selected: “*I tried it once and I was not selected, probably because I had no experience in making games.*” (P24).

**Motivations to participate.** Although participants had strong reasons not to participate in hackathons and game jams, many women openly mentioned **learning** and **networking** their main motivations to participate, as illustrated in the quotes below:

*“the possibility of learning and sharing ideas with other people”* (P38)

*“I would like to interact more with other people in the field, in addition to acquiring knowledge”* (P21)

*“I find it very interesting due to the [acquired] knowledge and networking”* (P31)

*“The motivating aspects are the knowledge acquired, the opportunity for mentoring and experience”* (P43)

## V. DISCUSSION

### A. Research Questions

After presenting the separate analysis of our data sources, we converge the findings and come back to the research questions that motivated our work in the next paragraphs.

#### **RQ1. What are the Typical Gender-Related Problems Women Face in Hackathons and Game Jams and How the Perspective of Men Differ in Regards to That Problem?**

According to the open-ended questions, the most frequent problems gender-related problems that women face in those events are related to the predominantly male environment, which triggers discomfort in many participants; women skills being underestimated by men; difficulties in team formation due to prejudice from men; having no voice in their teams, and suffering different types of harassment. Some of these problems were also witnessed by men, who reported seeing

women having their skills underestimated, having no voice in their teams, and suffering harassment, however, most of them did not point out problems or tried to see some of these issues as “normal”. Although we attempt to create a more welcoming environment for women when organizing female-focused events, we notice that allyship from a different gender is also important [38]. The prejudice during team formation mostly happens to women, but segregating women from men in different teams due to fear of having no voice or fir being underestimated can improve the hostile environment and the lack of dialogue. The closed-ended questions helped to better understand the differences in what men and women differ in regards to gender-related problems in hackathons. In sum, we concluded that women and men have a different perception of equality, inclusion and gender-biased treatment in time-bounded collaborative events. The difference in treatment and the experience with gender bias is much more evident among women in all events studied.

#### **RQ2. How Women Perceive their Motivations and their Experience When Participating in Such Events?**

Learning was the main motivation for women who joined the hackathons and game jams we surveyed, which confirms the general motivation of mixed-gender hackathon and game jam participants [16], [39]. In an attempt to create a more welcoming environment for women, three of the events we organized targeted mainly women. According to the feedback we directly receive from women participating in these events, they reported a great experience and agreed that hackathons and game jams focused on the female audience were essential to stimulate their participation in events of this nature, so they can learn new things and get to know other people. Attendees explained the event was a gateway, in which they saw their potential and felt more secure and empowered to participate in future mixed-gender events.

#### **RQ3. What Deters Some Women From Participating?**

Low confidence about technical abilities and predominantly male environment were two concerns for not joining hackathons or game jams that were also confirmed as real problems by the participants of the 8 events we surveyed. Thus, the fears of non-participants are reasonable. The majority of non-participant respondents said they have already considered taking part in such events. Coincidentally, their motivations to join a hackathon or game jam were also the same as participants aspect that showed some overlap for both participants and non-participants: **Learning** and **networking**. Considering the answers of 80.9% of non-participants having the intention to participate in hackathons and game jams, but many of them reporting different reasons for being insecure to do so, such as low confidence about technical abilities and lack of opportunities. Our results indicate that women need encouragement to attend these events, so they can take advantage of the learning and the exchanges that take place.

### B. Recommendations

Based on our experience organizing several hackathons and game jams, and after analyzing the responses of participants

and people who never participated in these types of events, we propose the following advice and ideas to host events that encourage women to have broader participation, increase their learning opportunities and improve their overall experience:

- *Focus more on collaboration and less on competition* - Our results show that learning and networking are key motivations for women – either non-participants and participants – to join hackathons and game jams. Thus, we suggest that organizers could plan events that concentrate less on the competition among teams. Such competitive aspect of game jams and especially hackathons may discourage some people. Of course, having a prize is an important aspect of some events, we believe that winning should not be promoted as their ultimate goal. Women are stimulated to share their experience and collaborate with peers, but they expect a welcoming environment for them. It will also address the fear that many women participants have regarding their performance.
- *Stimulate development of technical and soft skills* - Hackathons and game jams are powerful tools for participants to learn and put in practice their technical and soft skills. Students can acquire new competencies and have hands-on experience that complements their academic degree. We observed some participants have low confidence on their abilities. To increase their morale, it would be interesting to include training workshops and provide resources that participants can study before the events. In addition, the fun and learning aspects should be emphasized during the events.
- *Promote healthier habits* - Another aspect that inhibits women participation is the intensive format of events. Staying overnight may contribute to low productivity and may be impractical for women with children. In fact, we observed that some women feel uncomfortable spending the night at the venue. Therefore, we suggest alternative schedules to attract more women. It is also important to create a friendly space where women feel safe. In addition, the availability of mainly junk food was considered a negative aspect by many participants of our events. Providing healthy food and fun moments for relaxing during social breaks may create a well-being ambience.
- *Define an inclusive code of conduct* - Frequently, hackathons worldwide follow guidelines from the Hack Day Manifesto<sup>4</sup>. We believe that defining an appropriate code of conduct that reassure women can be an effective mechanism to create an inclusive culture in events. It outlines a set of rules, norms and appropriate actions for participants. For example, organizers should establish practices that guarantee all participants have an equal voice, have the opportunity to play the role they feel capable of, and prevent discrimination.
- *Include women in the organization team* - In some events we organized, we observed that the presence of women in

the organization can establish a less intimidating environment for female participants creating a sense of belonging for them. In fact, we obtained explicit feedback from women regarding the importance of inviting women to act as mentors and part of the judging panel. In addition, staff should be effective in preventing inappropriate situations and negative attitudes of participants.

### C. Limitations of this Study

In this section, we discuss the main threats to the validity of this study and how we attempted to address them. A major threat to validity involves the coding process because coding is essentially a creative task. To ensure a similar understanding and reduce research bias on the thematic analysis, we exhaustively discussed the coding process among the authors. A further threat arises from the fact that we cannot validate our conclusions with the participants due to the anonymous nature of our survey. Regarding a threat of external validity, we had limited the number of responses. All events' participants are based in the same city. Therefore, we consider viewpoints may be influenced by specific cultural values of participants from this region.

## VI. CONCLUSIONS AND FUTURE WORKS

Learning, along with networking, are the main motivations for women to join hackathons and game jams. These motivations were confirmed by participants of events we organized in Recife (Brazil) as well as women from the same region who never participated in such events but had intentions to do so. Hackathons and game jams create an environment where informal learning takes place, allowing peers with a multidisciplinary background to share ideas and knowledge. Due to the sexist culture around programming, games, and STEM, in general, the typical behavior of men in these events create a sometimes unpleasant experience for women participants and also repels those who never participated. Our studies reveal that hackathons and game jams targeted especially at women are able to create a support network where women feel more confident of their competencies. Nevertheless, mixed events need to prevent the "brogrammer stereotype" by successfully embracing women in a protective and welcoming environment so they can be more gender-inclusive. Changing the culture in the micro-level of hackathon and game jams can be a starting point for a broader women-friendly transformation in the computing area. This transformation is beneficial for everyone, since more diversity means a greater range of visions and experiences, increasing collective creativity towards the resolution of problems. As future work, we plan to conduct in-depth qualitative interviews with women to understand whether their participation in the events impacted their academic and professional experiences. We want to explore the potential benefits that hackathons and game jams may bring for their careers. In addition, we aim to understand how these events can build core professional competencies of participants.

<sup>4</sup><http://hackdaymanifesto.com/>



## REFERENCES

- [1] M. Komssi, D. Pichlis, M. Raatikainen, K. Kindström, and J. Järvinen, "What are hackathons for?" *IEEE Software*, vol. 32, no. 5, pp. 60–67, 2014.
- [2] A. Filippova, B. Chapman, R. S. Geiger, J. D. Herbsleb, A. Kalyanasundaram, E. Trainer, A. Moser, and A. Stoltzfus, "Hacking and making at time-bounded events: Current trends and next steps in research and event design," in *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*, 2017, pp. 363–370.
- [3] A. Kultima, "Defining game jam," in *Foundation of Digital Games (FDG)*, 2015.
- [4] A. Fowler, F. Khosmood, A. Arya, and G. Lai, "The global game jam for teaching and learning," in *Proceedings of the 4th Annual Conference on Computing and Information Technology Research and Education New Zealand*, sn, 2013, pp. 28–34.
- [5] S. Willis, G. Byrd, and B. D. Johnson, "Challenge-based learning," *Computer*, vol. 50, no. 7, pp. 13–16, 2017.
- [6] M. E. Madden, M. Baxter, H. Beauchamp, K. Bouchard, D. Habermas, M. Huff, B. Ladd, J. Pearson, and G. Plague, "Rethinking stem education: An interdisciplinary steam curriculum," *Procedia Computer Science*, vol. 20, pp. 541–546, 2013.
- [7] M. H. Land, "Full steam ahead: The benefits of integrating the arts into stem," *Procedia Computer Science*, vol. 20, pp. 547–552, 2013.
- [8] A. Nandi and M. Mandernach, "Hackathons as an informal learning platform," in *Proceedings of the 47th ACM Technical Symposium on Computing Science Education*. ACM, 2016, pp. 346–351.
- [9] J. Warner and P. J. Guo, "Hack. edu: Examining how college hackathons are perceived by student attendees and non-attendees," in *Proceedings of the 2017 ACM Conference on International Computing Education Research*, 2017, pp. 254–262.
- [10] A. Fowler, "Informal stem learning in game jams, hackathons and game creation events," in *Proceedings of the International Conference on Game Jams, Hackathons, and Game Creation Events*, 2016, pp. 38–41.
- [11] E. W. Robelen, "Steam: Experts make case for adding arts to stem," *Education week*, vol. 31, no. 13, p. 8, 2011.
- [12] S. Cheryan, V. C. Plaut, P. G. Davies, and C. M. Steele, "Ambient belonging: how stereotypical cues impact gender participation in computer science," *Journal of personality and social psychology*, vol. 97, no. 6, p. 1045, 2009.
- [13] B. A. Kos, "The collegiate hackathon experience," in *Proceedings of the 2018 ACM Conference on International Computing Education Research*, 2018, pp. 274–275.
- [14] A. Kerr, J. D. Savage, and V. Twomey-Lee, "Decoding and recoding game making events for diversity, inclusion and innovation," 2020.
- [15] S. J. Carr and A. Lassiter, "Big data, small apps: premises and products of the civic hackathon," in *Seeing Cities Through Big Data*. Springer, 2017, pp. 543–559.
- [16] G. Briscoe, "Digital innovation: The hackathon phenomenon," *Creative-works London*, vol. 6, pp. 1–13, 2014.
- [17] J. K. Silver, D. S. Binder, N. Zubcevik, and R. D. Zafonte, "Healthcare hackathons provide educational and innovation opportunities: a case study and best practice recommendations," *Journal of medical systems*, vol. 40, no. 7, pp. 1–7, 2016.
- [18] J. Wyngaard, H. Lynch, J. Nabrzyski, A. Pope, and S. Jha, "Hacking at the divide between polar science and hpc: using hackathons as training tools," in *2017 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW)*. IEEE, 2017, pp. 352–359.
- [19] C. Anslow, J. Brosz, F. Maurer, and M. Boyes, "Datathons: an experience report of data hackathons for data science education," in *Proceedings of the 47th ACM Technical Symposium on Computing Science Education*. ACM, 2016, pp. 615–620.
- [20] Y.-C. Tu, G. Dobbie, I. Warren, A. Meads, and C. Grout, "An experience report on a boot-camp style programming course," in *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*. ACM, 2018, pp. 509–514.
- [21] K. Gama, B. Alencar Gonçalves, and P. Alessio, "Hackathons in the formal learning process," in *Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education*. ACM, 2018, pp. 248–253.
- [22] M. Meriläinen, R. Aurava, A. Kultima, and J. Stenros, "Game jams for learning and teaching: a review," *International Journal of Game-Based Learning (IJGBL)*, vol. 10, no. 2, pp. 54–71, 2020.
- [23] R. Aurava, M. Meriläinen, V. Kankainen, and J. Stenros, "Game jams in general formal education," *International Journal of Child-Computer Interaction*, vol. 28, p. 100274, 2021.
- [24] A. Fowler, J. Pirker, and A. Arya, "Jamming across borders: An exploratory study," in *International Conference on Game Jams, Hackathons and Game Creation Events 2020*, 2020, pp. 16–21.
- [25] J. Falk Olesen and K. Halskov, "10 years of research with and on hackathons," in *Proceedings of the 2020 ACM Designing Interactive Systems Conference*, 2020, pp. 1073–1088.
- [26] A. Salter, "Code before content? programmer culture in games and electronic literature," *Hyperrhiz: New Media Cultures*, no. 17, 2017.
- [27] G. T. Richard, Y. B. Kafai, B. Adleberg, and O. Telhan, "Stitchfest: Diversifying a college hackathon to broaden participation and perceptions in computing," in *Proceedings of the 46th ACM technical symposium on computer science education*, 2015, pp. 114–119.
- [28] L. Paganini and K. Gama, "Engaging women's participation in hackathons: A qualitative study with participants of a female-focused hackathon," in *International Conference on Game Jams, Hackathons and Game Creation Events 2020*, 2020, pp. 8–15.
- [29] B. A. Kos, "Understanding female-focused hackathon participants' collaboration styles and event goals," in *Proceedings of the International Conference on Game Jams, Hackathons and Game Creation Events 2019*, 2019, pp. 1–4.
- [30] H. W. Kennedy, "Game jam as feminist methodology: The affective labors of intervention in the ludic economy," *Games and Culture*, vol. 13, no. 7, pp. 708–727, 2018.
- [31] Z. Wang, Y. Wang, and D. Redmiles, "Competence-confidence gap: A threat to female developers' contribution on github," in *2018 IEEE/ACM 40th International Conference on Software Engineering: Software Engineering in Society (ICSE-SEIS)*. IEEE, 2018, pp. 81–90.
- [32] C. Ferraz and K. Gama, "A case study about gender issues in a game jam," in *Proceedings of the International Conference on Game Jams, Hackathons and Game Creation Events 2019*, 2019, pp. 1–8.
- [33] G. Tapia-González, "Educational marketing and hackathon for candidate student recruitment," in *International Conference on Applied Human Factors and Ergonomics*. Springer, 2020, pp. 431–437.
- [34] E. P. P. Pe-Than, A. Nolte, A. Filippova, C. Bird, S. Scallen, and J. D. Herbsleb, "Designing corporate hackathons with a purpose: the future of software development," *IEEE Software*, vol. 36, no. 1, pp. 15–22, 2018.
- [35] R. B. Johnson and L. Christensen, *Educational research: Quantitative, qualitative, and mixed approaches*. Sage publications, 2019.
- [36] J. C. Williams and S. Mihaylo, "How the best bosses interrupt bias on their teams," *Harvard Business Review*, vol. 97, no. 6, pp. 151–+, 2019.
- [37] L. Rothman, "A cultural history of mansplaining," *The Atlantic*, vol. 1, 2012.
- [38] J. Sumerau, T. D. Forbes, E. A. Grollman, and L. A. Mathers, "Constructing allyship and the persistence of inequality," *Social Problems*, vol. 68, no. 2, pp. 358–373, 2021.
- [39] A. Arya, J. Chastine, J. Preston, and A. Fowler, "An international study on learning and process choices in the global game jam," *International Journal of Game-Based Learning (IJGBL)*, vol. 3, no. 4, pp. 27–46, 2013.