

# Hack4women: In search of a framework

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## Abstract

Gender disparity remains one of the most persistent and predominant inequalities worldwide. According to the World Economic Forum's 2023 survey, only 68.4% of the gender gap has been closed, suggesting that it will take 131 years to reach full parity [1]. In this context, the implementation of gender-themed hackathons is proposed as an innovative solution to promote equality in STEM contexts. In Chile, the Hack4women initiative, which has three versions, is positioned as a model to follow to work on reducing the gender gap through this type of initiatives. The main objective of this work is to lay the foundations for creating a model that allows this type of hackathon to be replicated in other contexts and countries. A study of the developed versions is carried out as a basis for establishing a methodological framework for the organization and execution of gender-themed hackathons, incorporating metrics and good practices for the development of a successful and impactful hackathon.

## Keywords

Hackathon, gender gap, methodological framework, STEM, proposed solutions.

## 1. Introduction

The gender gap continues to be one of the most persistent and outstanding inequalities in society worldwide. Despite the countries' efforts, statistics show limited progress on the issue. Gender equality, one of the sustainable development goals set out by the United Nations, seeks to provide girls and women with equal access to education, health care, work and representation in decision-making [2]. The causes of the gap are varied, including biological factors, cultural traditions, social expectations that trigger differences in education, inclusion in the workplace, and adoption of emerging technologies [3][4][5]. According to a UN Women report, girls and women have been significantly affected by the socioeconomic consequences of the pandemic. This demonstrates how crises can exacerbate gender inequality and threaten progress towards equity [6].

In 2021, the WHO reported that one out of three women suffered physical or sexual violence, representing 35% of the world's population [7]. The ENUSC Report of the Undersecretariat for Crime Prevention shows an increase in psychological, physical or sexual violence against women from 38.2% in 2017 to 41.4% in 2020[8].

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In the workplace, women face occupational segregation, inequality of opportunity and lower wages [9], earning 23% less than men and also dedicating triple of their time to unpaid domestic and care work compared to men, and continue to face discrimination when trying to access public office [10].

Although women have greater access to education than they did 50 years ago they still lag behind in most countries [11]. This educational inequality leads to repercussions such as wage inequities, less representation in political and economic decision-making, and an alarming prevalence of violence against women [8][10][12].

In STEM areas, women represent only 26% in technology and 28% in science [13], facing obstacles such as lack of female role models, gender bias, inequality of opportunities and salaries [14][15].

The gender gap in STEM areas remains significant, with only 30% of the student population being women globally [1]. In Chile, only 8% of women graduated in STEM areas in 2022, one of the lowest percentages in the OECD [16]. Studies [17] point to factors such as gender stereotypes in social, family and cultural settings [18] [19], and the belief in lower mathematical [18] [20] and technological [21] ability of women, influenced by unbiased teacher training [21]. Many teachers underestimate girls' mathematical abilities, which influences the gender gap in mathematics [22].

A study by the Economic Policy Institute highlights how social expectations and norms influence women's educational and professional decisions [23]. The lack of to sense of belonging to the system and the absence of female role models also contribute to women's disenchantment in STEM fields [24].

The European Union has funded projects to reduce the gender gap. In [10] an analysis of projects focusing on the gender gap in STEM is carried out, the result is that 74.19% of the projects focus on intervention, 3.23% on diagnosis and 22.58% on both. There are several programs to reduce the gender gap. The UNESCO SAGA project stands out, providing tools to increase women's visibility and participation [25]. The World Bank promotes "The Equality Equation" to address gender biases in learning materials and encourage female participation in STEM [26]. The European Union, through Erasmus+, funded the W-STEM project to attract, access and retain women in STEM careers in higher education institutions [27].

Given the context, it is proposed to carry out gender-themed hackathons to generate fast and effective solutions. Hackathons are powerful tools that foster creativity, critical thinking and problem solving, creating solutions to specific challenges into collaborative and multidisciplinary way [28][29], gaining popularity, covering areas such as technology, business and social causes, fostering innovation and bringing together diverse talent to solve complex problems. Although they are effective in generating fast and creative solutions, they face challenges such as the variety of formats, the lack of connection between end users and participants, and the limited time that can result in unpolished or incomplete solutions [30].

This study proposes a methodological framework for gender-themed hackathons that is replicable, measurable and scalable. It will include a literature review on frameworks and metrics and the design of a new framework with stages, roles and evaluation criteria focused on social impact and participant satisfaction. The framework will be validated in Chile and then internationally. The objective is to offer an efficient,

scalable and replicable framework, along with good practices and a clear guide for the organization of gender hackathons.

This paper consists of six sections. The second section contextualizes previous studies on gender hackathons, frameworks, and metrics. The third section describes Hack4women, including its objective, structure, and outcomes. The fourth section analyzes the strengths, opportunities, weaknesses, and threats of Hack4women and its main findings.

The fifth section presents the research plan for the Hack4women framework. The sixth section details the contributions and benefits of the research.

## **2. Present situation**

### **2.1. Women and their relationship with STEM**

In Chile, women represent 54% of enrollments in undergraduate programs, only 21% in STEM fields [16]. In 2021, only 18% of STEM graduates were women, a figure that decreased to 8% in 2022, leaving Chile among the countries with the lowest percentage in the OECD. In 2023, between 37% and 41% of those working in research and development were women. Patent applications by Chilean women varied between 17% and 25% in the last decade and only 35% of indexed scientific publications were led by women. This shows a limited contribution to scientific and technical knowledge and a lack of presence in key activities for technological innovation.

In 2021, only 38% of the projects funded by the National Agency for Research and Development (ANID) were led by women, showing the disparity in research leadership. This fact is repeated in other countries; in Spain, 54% of university students are women, but only a quarter in engineering and architecture [14]. In technology companies such as Facebook, Twitter, Apple and Google, female representation is low, between 10% and 20%. In communities such as Stack Overflow, participation is 10% [14].

Several factors discourage women from studying STEM programs [30][31][18][19][20][21][17]. Gender stereotypes rooted in social, family and cultural settings in Latin America [18][19], the lack of female role models in STEM [14][31] and conscious and unconscious biases in education discourage women from studying STEM programs [21]. Another factor refers to the perception of lower mathematical [18][20] and technological [21] ability, and the idea that certain disciplines are "for men" also limit their participation.

### **2.2. STEM-related hackathons**

Hackathons have evolved from coding marathons to instruments of social impact and inclusion.

Barriers and incentives for women's participation in hackathons go beyond representation, influencing the outcomes and solutions generated [32]. Challenging biases and promoting self-esteem and self-confidence is crucial to improving gender representation [33].

Gender-themed hackathons seek to promote equity in male-dominated fields and address issues that disproportionately affect women and non-binary people [33]. Incorporating these themes responds to the need for diversity and equality in technology and innovation, providing an inclusive space for all genders and encouraging female and non-binary participation.

The results of these initiatives generate innovative solutions and increase the participation of women and non-binary people in technology, promoting gender equity and incorporating diverse perspectives in the innovation process [32].

Mixed teams at hackathons achieve more diverse products and solutions, fostering inclusive design [34] and empowering participants by expanding their network [33]. Some hackathons have led to the formation of new startups with a greater female presence [35], promoting awareness of the gender gap in technology [36] and challenging gender stereotypes [33]. Hackathons contribute to gender equality in digital innovation [34], offering a model for other similar events.

“Hello Diversity! Digital Ideation Hackathon” focused on fostering gender equality in digital innovation by bringing together diverse participants to come up with strategies to reduce gender inequality in the workforce [34]. The event’s outcomes highlighted the importance of diverse perspectives in innovation and the role of hackathons as catalysts for change in corporate and educational settings.

The Pakistan hackathon, focusing on emergency preparedness in schools, highlighted the importance of including female voices in problem solving [35].

The results of these events indicate that gender-equal hackathons break stereotypes and generate more diverse and innovative solutions. Gender-neutral hackathons can serve as talent incubators and safe spaces for women and minorities to develop skills in technology and leadership [36].

### **2.3. Frameworks for Hackathons**

Several studies have worked to provide a framework for understanding and organizing hackathons [37][30][38][39]. These events have evolved over two decades from informal events to structured platforms used by companies to drive innovation, learning, and prototyping.

In [39] a framework for organizing hackathons is presented, based on the existing literature, defining three crucial phases. The first phase clearly emphasizes defining the hackathon objectives, including the approach, recruitment, format, atmosphere and logistics planning. The second phase focuses on the temporal structure, coordination, ideation, idea selection, execution and evaluation of projects. The third phase addresses the continuity of the projects after the hackathon, which is essential to capitalize on the efforts and ideas generated.

The study [37] offers a systematic overview of the organization of hackathons, identifying ten activities in three phases: pre-hackathon, hackathon and post-hackathon. The activities range from defining objectives to post-event evaluation and follow-up. [38] provides detailed guidance on twelve key decisions for the organizers, ranging from defining objectives to planning duration, breaks and team building. It highlights the importance of stakeholder involvement and the provision of specialized training or resources depending on the hackathon theme.

The study [30] proposes a new methodology to organize university hackathons, integrating Challenge-Based Learning and Design Thinking, optimizing the ideation phase and generation of significant ideas and prototypes, promoting practical and collaborative experience-based learning for students.

## 2.4. Measuring Hackathons

Using metrics helps to evaluate the success of hackathons by providing clear criteria for measuring performance and results. These metrics ensure that activities and resources are aligned with objectives.

Metrics for evaluating hackathons vary depending on the type and objective of the event, and may focus on immediate results and long-term impact [29]. The success of these events depends on both tangible results and participants' experiences and impact [40][41]. Considering the viability of solutions is crucial, given that many are not sustained [41].

To fully achieve the success of a hackathon, it is crucial to establish metrics that address both tangible outcomes and intangible impacts. Defining these metrics ensures that objectives are met and contributes to the overall success of the event.

To measure the success of hackathons, it is essential to assess the interest of participants, mentors and stakeholders. Post-event surveys help to identify their experiences regarding the organization, activities, topics addressed and results of the event [29]. It is important to know the number of participants, the retention rate and the diversity of profiles, as well as the quality of the mentors and stakeholders to motivate and engage all those involved [39].

Metrics that assess the quantity and quality of the proposals developed during the event are crucial. For this measurement, the innovation, functionality and relevance of the solutions can be assessed [39]. It is necessary to measure the potential impact or application of the ideas developed, as well as their innovation, viability and sustainability of the solution proposals in order to know their projection.

Assessing sustainability involves determining how many projects continue to be developed after the event, which is a key factor for the success of the initiative [41]. Measuring the number of solutions implemented in real cases allows assessing their real or potential impact, including practical application and contribution to solving specific problems [44]. Metrics are essential to identify strengths and opportunities for improvement in these events.

## 3. Hack4women Initiative

In order to help reducing the gender gap in STEM careers, the Faculty of Engineering at Andrés Bello University created the Hack4women initiative in 2021, which already has three editions (2021, 2022 and 2023). The objective of this initiative is to propose solutions to reduce the gender gap in STEM, educate and make visible the importance of gender equality.

Hack4women is divided into three stages, which are detailed below.

The first stage focuses on identifying the problems faced by women in STEM areas. During this phase, meetings are held with experts, such as the Regional Ministerial Secretariat of the Ministry of Women and Gender Equality (SEREMI), who provide information on the possible causes of the demotivation of girls and women in these areas. The social perception on this topic is collected through a citizen survey, the results of which are analyzed to identify the main pains that give rise to the tracs for the hackathon. In addition, mentors are contacted to guide the participants, affected people, called pain representatives, are invited to share their experiences with the participants, and a call is made to participate in the event.

The second stage is Hack4women. Here, teams learn to identify needs, come up with valuable solutions, package needs, create prototypes and create the *pitch* for their proposals. Mentors guide the teams through each phase to ensure that the solutions are viable and have

an impact. The teams also participate in virtual sessions with pain representatives who share their experiences and discuss their needs, in this way the teams can deepen and empathize with the conditions detected. Additionally, videos are presented with testimonies from women affected in each of the work stages.

The third stage of the event consists of the evaluation of the proposals. Each team presents its solution through a pitch and a jury selects the three proposals with the greatest impact and viability. The results of the three versions are detailed in Table 1.

**Table 1**  
Hackathon results

	1st version 2021	2nd version 2022	3rd version 2023
Number of participants	316	174	133
Number of mentors proposed solution	17	15	14
Number of Pitch Mentors	5	6	5
Number of monitors	10	5	5
Number of teams	35	36	31
Number of proposed solutions	30	25	20
hack4women duration	3 days	1 day	1 day

The solutions generated include educational games and activities about women leaders in STEM, the creation of a community of researchers to promote female leadership, a web portal with information about researchers and their work, and various initiatives to mentor students interested in STEM, with the aim of inspiring and guiding the next generation.

#### 4. Hack4women Analysis

While this initiative has enabled us to provide a comprehensive approach to understanding and addressing the gender gap in STEM areas, detecting the main problems faced by women in these areas, raising awareness about the importance of the issue and generating concrete solutions to promote gender equality, a framework and metrics are required to replicate and scale the initiative to different parts of the world.

For this purpose, a strengths, weaknesses, opportunities and threats (SWOT) analysis was carried out to determine the contribution and impact of the initiative on gender equality. The main findings detected are detailed in Table 2.

**Table 2**  
Hack4women SWOT Findings

Strengths	Opportunities	Weaknesses	Threats
Experience and continuity with three versions of the event.	Possibility of international expansion of the event.	Low diversity of participants, limited to engineering students.	Gender stereotypes rooted in society.
Collaborative and multidisciplinary approach with participation of the state, business and academia.	Opportunity to attract a larger number of participants.	Lack of knowledge of post-event materialized solutions.	Social and cultural barriers limit participation and impact.

Using citizen surveys to understand specific problems.	Creating a virtuous circle between academia, industry and state.	The lack of a long-term monitoring and evaluation system.	Possible changes in priorities within the institution may affect continuity and financing.
Inclusion of direct testimonials, adding value and relevance.	Potential to implement the generated proposals.	Absence of a defined framework to guide the initiative.	Legal, technical and economic obstacles to the implementation of proposals.
Generation of 75 proposals, indicating a high level of participation.	Attracting funding and support through visibility and impact.	Lack of evaluation metrics for tangible and intangible results.	Dependence on own capital for the materialization of solutions.
Application of a methodology that encourages creativity and practical solutions. Emphasis on education and awareness on gender equality.	Influencing public policy formulation to promote gender equality in STEM.	Lack of a sustainability model for the initiative.	Need for rapid adaptation to the constant evolution of STEM.

## 5. Hack4women Methodological Framework

Research will be conducted using the *Action Research methodology*, which integrates theory and practice, and is carried out through cycles of planning, action, observation and reflection. The cycles continue until the research objectives are met [42][43]. The research includes two cycles with their corresponding stages. The description of both cycles, along with each phase, is detailed below.

Cycle 1 aims to create and implement a framework for the development of a gender-themed hackathon. In the diagnostic stage, a literature review is carried out to identify the frameworks and their characteristics, collecting metrics and good practices applied in hackathons. In parallel, a citizen survey will be designed and applied in order to find out the main problems faced daily by women in STEM areas in Chile. In the action stage, the framework will be designed with the stages and tasks involved, along with the good practices to be incorporated and responsible roles that guarantee an impactful hackathon along with its replicability and scalability. To facilitate the implementation of Hack4women, a *roadmap will be created*, that allows to visualize the stages together with their tasks and roles, in the evaluation stage the proposed framework will be validated at a national level, for this purpose the Hack4women Chile will be carried out, the reflection stage will consist of the evaluation of the metrics selected as a result of the literature review, it will be analyzed if any adaptation is required to the framework and to the qualitative instrument (citizen survey) to be applied at an international level.

Cycle 2 aims to validate the scalability and replicability of the proposed framework. To this end, in the diagnosis stage, an international citizen survey will be applied to find out the main problems in STEM. In the action stage, adjustments will be made to achieve the replicability and scalability of the model. In the evaluation stage, the framework will be validated by carrying

out the international Hack4women. Finally, in the reflection stage, the scalability and replicability of the framework will be measured using the selected metrics.

## **6. Conclusions**

The gender gap in areas such as education, employment and political leadership persists as a significant challenge globally. Despite international efforts to address these inequalities, progress has been slow and disparities remain evident, especially in STEM areas, where women are notably underrepresented. This study highlights the critical importance of addressing these inequities not only from a regulatory or legislative approach, but also through the implementation of innovative initiatives such as gender-themed hackathons. These events represent an exceptional opportunity to foster the creativity, critical thinking and collaborative skills needed to generate effective and sustainable solutions.

Hackathons, by bringing together people from diverse backgrounds and specialties, facilitate the creation of solutions that are not only inclusive but also broadly applicable and capable of addressing the specific needs of women in STEM fields and beyond. Furthermore, by promoting the active participation of women in these events, their empowerment is enhanced and the entrenched gender stereotypes that often limit their participation in these fields are challenged.

Hack4Women is a hackathon initiative designed to address pressing social issues through technology and gender-themed collaborative innovation. Advantages of Hack4Women include fostering rapid innovation, networking between professionals from different industries, and generating practical solutions to real problems in a short time. However, drawbacks can include a lack of post-event follow-up, which sometimes results in projects not being implemented in the long term. Furthermore, transferring the event to other contexts is difficult as there is no model that allows for easy adaptation. On the other hand, there is a need to incorporate metrics to be able to measure the real impact of the initiative.

This proposal lays the foundation for developing a scalable and replicable methodological framework for conducting gender-themed hackathons, also providing metrics and good practices to determine the success of the event. The initiative involves the collaboration of different sectors of society, highlighting academia, industry and government, creating a multi-sector collaboration that allows the exchange of ideas and development of strategies to promote gender equality.

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