


How Ready for HCI? A Qualitative Analysis of the Practice of Soft Skills Related to HCI by Women Involved in the Digital Girls Program Partners Projects

Sofia Bento Desidério   [Federal University of Ceara | sofiadesiderio@alu.ufc.br]

Maria Rebecca Lopes Lelis  [Federal University of Ceara | marialopeslelis@alu.ufc.br]

Maria Elanne Rodrigues  [Federal University of Ceara | elannemendes@alu.ufc.br]

Anna Beatriz Marques  [Federal University of Ceara | beatriz.marques@ufc.br]

 Campus de Russas, Federal University of Ceara, Avenida Felipe Santiago, 411, Campo Federal, Russas, CE, 62900-420, Brazil.

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Abstract The Digital Girls Program (DGP) partner projects undertake various activities that impact their members' academic and professional development. In this context, socio-emotional skills or soft skills can be highlighted. This article is an extension of research investigating evidence of soft skills in experiences reported by female students and coordinators participating in DGP partner projects. In the original research, soft skills relevant to Computer Science were investigated. This extension, in turn, explores soft skills specific to Human-Computer Interaction (HCI). For data collection, a survey was conducted with DGP partner projects. The data analysis method employed was qualitative analysis, based on coding procedures to identify evidence of soft skills in respondents' narratives. The actions promoted by partner projects were mapped to characterize the participating projects in the survey. As a result, leadership, professionalism, and communication were identified and are related to Computer Science and HCI. Specifically regarding HCI, evidence of critical thinking, empathy, and collaboration was identified. Thus, it is observed that women participating in partner projects develop soft skills relevant to HCI, which is a positive factor for their involvement in this field.

Keywords: Digital Girls Program, Survey, Soft Skills, Computer Science, Human-Computer Interaction

1 Introduction

According to ABES, the technology industry experienced a 22.9% increase in 2022 [ABES, 2022]. However, the presence of women in Information and Communication Technologies (ICT) remains low, accounting for only 14.8% of the total, according to a study led by Brasscom [Brasscom, 2021]. To promote gender equity in ICT and engage more girls and women in this sector, the Digital Girls Program was created by the Brazilian Computer Society (SBC)¹.

Digital Girls originated from the Women in Information Technology (WIT) event, the cornerstone of the Brazilian Computer Society Congress (CSBC)³ [Maciel *et al.*, 2018]. It has around 93 active partner projects throughout Brazil, including international partnerships. These projects promote initiatives to encourage and support women interested in Computing and its technologies. Many partners are university extension projects for female students to reach high school and the final years of elementary school.

This research is an extension of the paper "Investigating the development of soft skills in partner projects of the Digital Girls Program: An exploratory study", Desidério *et al.* [2023] where the research question was: "Do the activities carried out by Digital Girls partner projects help develop soft skills in participants?" To answer this question, we con-

ducted a survey targeting female students and coordinators involved in the projects to collect information about the initiative's influence on their academic and professional trajectories and to map the reported soft skills.

From the results, we conducted an exploratory analysis of the actions of each project participating in the survey. These actions were discussed, classified, and categorized according to their impact on the university community and society. Sources included social media platforms such as Instagram⁴ and Facebook⁵, official SBC and educational institution websites, and online repositories. This article seeks to use the soft skills and actions mapped in the previous work and relate them to the profile of professionals in the field of Human-Computer Interaction (HCI) through a survey in similar studies that indicate which non-technical competencies are most relevant for pursuing a career in the field.

The remainder of this document is organized as follows: Section 2 presents a more detailed definition of soft skills; Section 3 discusses the methodology adopted in the study of the collected information; Section 4 describes the results obtained from the data evaluation; Section 5 suggests discussions; Section 6 reports the similarities of this study to other research; and finally, Section 7 presents the final considerations and visions for future investigation or improvement of this study.

¹<https://www.sbc.org.br/>

²<https://meninas.sbc.org.br/>

³<https://csbc.sbc.org.br/>

⁴<https://www.instagram.com/>

⁵<https://www.facebook.com/>

2 Background

For a comprehensive understanding, the following subsections lay the groundwork for the concepts addressed throughout the Methodology, Results, and Discussion sections. Initially, we examine the definition of soft skills and their significance in the workplace, with particular attention directed towards the field of Human-Computer Interaction (HCI). Afterward, we briefly explained soft skills' transferable nature and how they apply to our study. Finally, we delve into the context and organization of the Digital Girls Program, as they constitute the target audience of the questionnaire applied in this research.

2.1 Soft Skills

According to a survey conducted by LinkedIn⁶, a social network responsible for connecting people and professional interests, more than half of Human Resources leaders and interviewed managers assert that soft skills stand out in comparison to the formal competencies of candidates. With the advancement of technologies, the work context has changed, and nowadays, possessing technical qualifications has ceased to be an exclusively determining characteristic in the hiring process.

Soft skills are personal attributes that influence an individual's interaction with the environment and others. In addition to being more challenging to quantify, they require practical experiences to be enhanced since they are not solely derived from theoretical knowledge [Marques *et al.*, 2020]. Investing in their development brings benefits not only in the workplace but is also increasingly recognized in many other aspects, such as emotional well-being and quality of life.

Soft skills are crucial for early-career programmers to secure their first job in the software development market. According to the study "The Role of Non-Technical Skills in the Software Development Market", each job posting seeks professionals with an average of 6 non-technical competencies, with an emphasis on Teamwork, present in the majority of analyzed vacancies [Rabelo *et al.*, 2022]. In this sense, the growing importance of soft skills in the job market becomes evident.

2.1.1 Soft Skills in Human-Computer Interaction (HCI)

Human-Computer Interaction (HCI) is a naturally multidisciplinary branch of knowledge [Barbosa and Silva, 2010]. This characteristic arises from the need to understand human aspects and the "real world" for interactive systems to be functional for most users. In this sense, many students in the final years of their undergraduate studies may find themselves at a disadvantage when entering the job market, as higher education institutions often do not structure a curriculum capable of encouraging the development of soft skills [Seagull and Souza, 2023].

The impact of soft skills in HCI is a recent topic that has attracted the interest of various researchers. Figure 1 illustrates

a set of soft skills relevant to HCI practice and suggested by the researchers discussed in this section.

Rosala and Krause [2019] coded 358 comments from User Experience (UX) professionals and identified that non-technical competencies were mentioned in more than half of the sample. The soft skills mentioned were Communication, Empathy, Active Listening, and Teamwork. With Communication, the HCI professional can effectively convey ideas to any team member interested in the project's success. Empathy makes understanding clients' needs and expectations more immersive in brainstorming—a method used to generate innovative solutions. Active Listening aids in the development of Empathy and allows space for others to contribute different perspectives in resolving product interface inconsistencies, for example. Moreover, Teamwork influences collaborative relationships among colleagues, helping the HCI professional work with diverse and multidisciplinary teams.

To better understand the current expectations for working in the UX industry, Rose *et al.* [2020] interviewed senior UX industry professionals to learn what skills new employees need to work in UX successfully. They identified that Giving and Taking Critique, Storytelling, Handling Conflict, Persuading Others, Leading, Critical Thinking, and Creating/Innovating are relevant soft skills for the UX industry.

Giving and Taking Critique influences the improvement of design artifacts. When UX team members can engage with constructive and open criticism about each other's work, areas of improvement and their potential solutions become readily identifiable. Storytelling is directly related to understanding the user's journey. In other words, an HCI professional can craft narratives that meet the expected usage of design products.

Handling conflict is essential to ensure that the project's progress is not hindered by differences of opinion among team members, providing means to find common ground in each conflict. This competency also intersects with Leading; leaders possess the expertise to guide and encourage collaborative work. These individuals typically actively work to prevent conflicts, creating an inclusive environment. Another aspect of Leading is Critical Thinking, which involves a more refined thought process about the HCI atmosphere - where people and products align through the synthesis and objective analysis of information. Critical Thinking also contributes to decision-making.

Other complementary skills are Persuading Others and Creating/Innovating in a cycle of "give" and "take". When developing innovative solutions, the HCI professional must constantly think about communicating and persuading others about these ideas. Simultaneously, when persuading others, they must be open to the feedback received and how it relates to the solution. All of this occurs in a continuous process of innovation and creativity.

Using contextual interviews and an online survey of design practitioners, Ganci and Lahey [2017] explored what core competencies are expected of designers entering user interface design-related fields. They characterize the results as hard, malleable, and soft skills. Malleable skills refer to skills that either seem to have both hard and soft qualities or require an integration of both. The main soft skills identified in this study are Teamwork, Understanding Users, Giving

⁶<https://linkedin.com/>

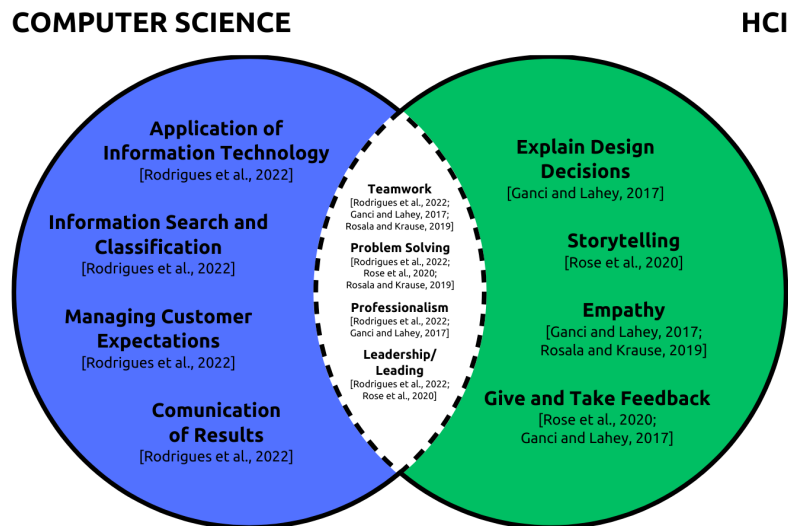


Figure 1. Venn Diagram to represent common and specific soft skills in Computing and HCI.

and Taking Feedback, Communication, Explaining Design Decisions, and Collaboration.

Collaboration helps UX team professionals exchange new ideas, technical knowledge, and tools. Understanding users requires an outward focus, enabling immersion in users' needs and expectations to meet them effectively. Additionally, the ability to Explain Design Decisions in various formats, whether to colleagues or other stakeholders invested in the project's success, helps ensure that everyone is aligned with the ongoing developments.

2.2 Transferable Nature of Soft Skills

Soft skills stand out due to their transferable nature, implying that a non-technical skill can be effectively expressed in various roles. In other words, this knowledge is not specific to a particular position; instead, it can be assimilated and applied throughout an individual's professional journey.

In this sense, no soft skill exclusively belongs to the field of Computing or HCI. However, it is worth noting that the degree of usefulness of some skills may vary depending on the area of expertise.

In this study, some competencies will be categorized as specific to HCI, while others will be categorized as related to Computing. It is essential to understand that, in some instances, the degree of relevance of these soft skills may be more pronounced in one area. However, there are skills for which the level of relevance is independent of the area, which is equally essential for both computing and HCI. In summary, we aim to analyze the relationship between competencies and their respective areas, recognizing the nuances of their relativity.

In the Venn Diagram depicted in Figure 1, it is possible to identify common soft skills between Computing and HCI. Additionally, some skills specific to each domain are observed (judged based on their degree of influence in that area), although they are not exclusive to one or the other. The soft skills used in the Venn Diagram can be found in Table 1 and Table 2 of the article.

2.3 Digital Girls Program

More women need to occupy significant roles in the current technology industry. This scenario arises from various reasons, all strongly influenced by the structural gender bias that defines social roles based solely on biological aspects.

The Digital Girls Program emerged to mitigate the impacts of gender stereotypes in Information and Communication Technologies (ICTs) [Maciel *et al.*, 2018]. The program focuses on female high school, technical, and elementary students through initiatives to introduce the field and motivate them to pursue a career. Actions undertaken by the Digital Girls include workshops, courses, activities, lectures, and events.

It is important to note that these actions can also be directed toward female students already involved in ICTs through undergraduate courses, intending to support them and prevent dropout, as the number of women graduating in Science, Technology, Engineering, and Mathematics (STEM) in Brazil is only 34%. This data becomes concerning when the female population comprises the majority, around 60%, of general undergraduate courses graduates [Nascimento *et al.*, 2023].

The Digital Girls is organized into partner projects, typically in higher education institutions, whether public or private [Maciel *et al.*, 2018]. Anyone can take on the responsibility of creating a partner project at their institution and be designated as the project coordinator. Currently, there are 93 active partner projects spread across all regions of Brazil and even internationally, in addition to 65 completed projects. Over 150 partner projects have impacted their regions by promoting gender diversity in ICTs.

3 Methodology

Figure 2 illustrates the methodology used for conducting this research. The methodology was divided into seven steps: (1) Conducting the survey; (2) Qualitative data analysis; (3) Categorization of actions; (4) Mapping of actions; (5) Classifi-

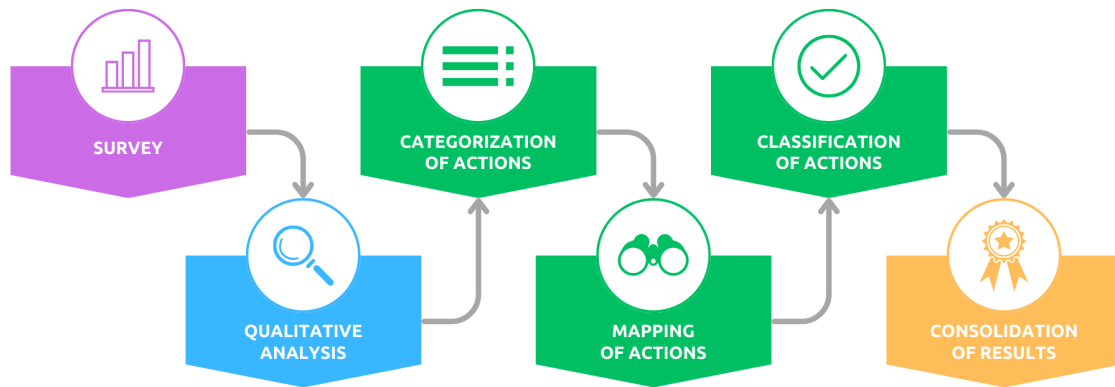


Figure 2. Research Methodology

cation of actions; (6) Extension of qualitative analysis, and (7) Consolidation of results. Each step will be described in the following subsections.

3.1 Survey

The research instrument used for data collection was a survey composed of both objective and subjective questions. The questionnaire was created using the Google Forms tool⁷ for broad dissemination through digital media.

The survey aimed to investigate female students' and coordinators' academic and professional development while participating in Digital Girls partner projects. The questionnaire was open for responses from January 28 to July 4, 2022. After this period, 45 responses from female students and 28 responses from coordinators were obtained. In total, 29 projects from all regions of Brazil responded to the survey.

The objective questions were analyzed, and their results are reported in the article "Engagement in Partner Projects of the Digital Girls Program and its Impact on the Academic and Professional Development of Female Students: a survey" [Lelis *et al.*, 2023]. The present study explores only subjective inquiries. The questionnaire administered to the students and coordinators comprised two open-ended questions. The first question aimed to comprehend how participation in the partner project influenced the academic and professional development of the participants, which was the focus for identifying soft skills and is displayed below. The second question inquired about the challenges faced during engagement in the project.

- **(Female Students)** *Can you tell us a bit about how participating in the project has influenced your academic and professional development?*
- **(Coordination)** *In what ways does coordinating the project influence your academic and professional development?*

All respondents in the questionnaire had to provide their consent through an Informed Consent Form. The research objectives, data collection methods, and how their data would be utilized were clearly described. All identifying information about any participant was handled with professional confidentiality standards and used solely for scientific

and academic purposes. Furthermore, the respondents' diversity was considered, and their cultural and social differences were recognized and respected.

3.2 Qualitative Analysis

A Thematic Analysis (TA) was conducted to analyze the survey results. TA is a qualitative data analysis methodology used to identify, analyze, interpret, and report patterns from qualitative data [Braun and Clarke, 2006]. The Qualitative Analysis was carried out by the authors of the original article [Desidério *et al.*, 2023].

The data collected in the research were organized according to the investigated questions. The researchers assigned a unique ID to each respondent to ensure data confidentiality. This measure was taken to prevent the identification of respondents during the analysis. Each female student was given an ID like A1, A2, and so on; each coordinator received an ID like C1, C2, and so on.

The Thematic Analysis examined the data to identify soft skills in specific excerpts of the participants' responses. To guide the analysis, the researchers decided to adopt the list of soft skills used by Rodrigues *et al.* [2022] in their Thematic Analysis, which encompasses soft skills relevant to working in the field of Computing. Table 1 describes the investigated soft skills. This analysis stage was carried out with the assistance of the ATLAS.ti tool⁸. The project coordinator, an expert in the subject, validated all steps of the qualitative analysis to ensure significant reliability in the results obtained.

Identifying soft skills from participants' responses is based on analyzing the relationship between excerpts from the responses and concepts associated with non-technical competencies in the respective field. In this initial phase, the list by Rodrigues *et al.* [2022] served as a reference for Computing soft skills. Additionally, another list was employed to map Human-Computer Interaction (HCI) soft skills in the extension of the Qualitative Analysis.

In the excerpt below, for instance, collected from a student, the non-technical competence of Oral Communication was mapped, showing a strong correlation with the description of the same competency in Table 1.

"Expressing thoughts and ideas clearly and effectively;

⁷<https://docs.google.com/forms/>

⁸<https://atlasti.com/>

Table 1. Relevant soft skills for Computer Science investigated in the Qualitative Analysis Rodrigues *et al.* [2022].

Soft skill	Description
Thinking/Problem Solving	Exercise reasoning and analytical thinking, using knowledge, facts, and data to solve problems.
Oral Communication	Articulate thoughts and ideas clearly and effectively; have the ability to speak in public.
Written Communication	Writing documents clearly and effectively; writing a report or manual correctly; editing different formal reports using templates.
Teamwork/Collaboration	Collaborative relationships with colleagues and clients; working with diverse teams, negotiating, and managing conflicts.
Diversity	Learning and working collaboratively with individuals representing diverse cultures, races, ages, genders, religions, lifestyles, and perspectives.
Application of Information Technology	Selecting and using appropriate technology to perform a specific task.
Leadership	Harnessing the strengths of others to achieve common goals.
Creativity/Innovation	Demonstrating originality and inventiveness in work, communicating new ideas to others, and integrating knowledge across different disciplines.
Lifelong Learning/Self-Directedness	Being able to acquire new knowledge and skills continuously, monitoring one's own learning needs, and being able to learn from one's own mistakes.
Professionalism/Work Ethics	Demonstrating personal responsibility, effective work habits, productive collaboration with others, and time and workload management.
Ethics/Social Responsibility	Demonstrating integrity and ethical behavior; acting responsibly, considering the interests of the community at large.
Information Search and Classification	Researching information about the company and the topic they will work on; searching and analyzing different sources; synthesizing all the excessive information they find; classifying and selecting relevant information.
Managing Customer Expectations	Managing client interests throughout the entire project and promptly responding to any queries or requested changes, especially changes in requirements and their implications.
Decision Making	Making significant decisions regarding the project's development.
Conflict Management	Resolving issues with the client or among team members at any point during the project development and preventing them from arising.
Critical Thinking	Critically evaluate the work done by other teams and engage in self-critique regarding one's project.
Results Assessment	Assessing artifacts made by other groups and selecting appropriate techniques to evaluate their artifacts.
Communication of Results	Presenting results accurately to the client, other students, and academics; communicating results to different individuals in unique formats and with varying levels of precision.

having the ability to speak in public.”

Atlas.ti tool is a coding facilitator, requiring manual identification and categorization. Its primary objective is to assist in data visualization and cross-referencing.

3.3 Categorization of Actions

Seven action categories were defined to organize and investigate the actions carried out by partner projects. The categories were established based on the work of [Marques *et al.*, 2019].

Social Media: Production of content on social media platforms.

Mentoring: Forums, discussions, and roundtable talks about gender and/or Computing for female students newly enrolled in IT courses.

Workshops: Dynamic teaching actions on technical topics in Computing.

Games/Challenges: Actions that use games and/or gamification to teach.

Lectures: Oral presentations on IT and/or gender diversity topics.

Events: A set of lectures/workshops/workshops that last one day or more.

Scientific Production: Writing and presenting scientific papers and/or abstracts.

3.4 Mapping of Actions

To gather information on the actions, publications from WIT were consulted in the SBC repository⁹, the official Digital Girls website, the official websites of institutions reporting project actions (universities, elementary, middle, and technical schools, etc.), as well as social media platforms such as Facebook, Instagram, and YouTube. Extracted data included the region, project name, and actions performed.

3.5 Classification of Actions

All partner projects that responded to the survey were placed in a Google Sheets spreadsheet¹⁰ to be checked concerning the actions performed and their objectives. The document had columns with the main actions developed according to the previously defined categorization, such as “Games/Challenges”, “Events”, and “Lectures”, where each row allocated a checkbox that assumed the value of true or false.

Regions of Brazil organized projects to facilitate visualization and task distribution among the researchers. To ensure the quality of the results, a rotation of reviews was carried out, with each mapping being approved by three authors of the original article [Desidério *et al.*, 2023]. The project coordinator was responsible for the final validation.

⁹<https://sol.sbc.org.br/index.php/wit>

¹⁰<https://www.google.com/sheets/>

3.6 Extension of Qualitative Analysis

In this extension of the Thematic Analysis, two researchers used the responses collected from the survey to identify other soft skills related to the human-computer interaction (HCI) field. The aim was to understand if women participants in partner projects also developed behavioral competencies useful for HCI.

We analyzed a set of works about soft skills in HCI Rosala and Krause [2019]; Rose *et al.* [2020]; Ganci and Lahey [2017] to guide the analysis. These studies were briefly described in Section 2.1.1. Based on them, we developed a table of soft skills necessary for working in the HCI market (Table 2).

To obtain the Table 2, one researcher created a list with all the soft skills mentioned in Rosala and Krause [2019]; Rose *et al.* [2020]; Ganci and Lahey [2017]. A second researcher analyzed the list to identify duplicated ones and proposed unification of some similar soft skills. After that, the researchers associated definitions for each skill based on the original works in which it was identified. Some skills identified by Ganci and Lahey [2017] were removed in this step because the authors did not define the skill, like “good character”.

The entire analysis was conducted with the assistance of ATLAS.ti, and for data visualization, the online tool Flourish¹¹ was used. One of the researchers, an expert in the field and the project coordinator, was responsible for validating the identified soft skills and contributing to the refinement of evidence.

3.7 Consolidation of Results

In this stage, we analyzed the relationship between the results obtained from the extension of the qualitative analysis and the results of the original research. Similarities and specificities of the soft skills in Computer Science and HCI were discussed.

4 Results

The following subsections display the identified soft skills resulting from Qualitative Analysis and the Extension of Qualitative Analysis. They also report their association with the actions the surveyed partner projects performed, obtained through Categorization, Mapping, and Classification of the Actions.

For those interested in a more in-depth exploration of participants’ responses and the data collection of partner project actions, it is accessible through Zenodo¹², an open repository for researchers, at the following link: <https://zenodo.org/records/10758300>.

4.1 Practice of Computer Science Soft Skills in Partner Projects

As a result of the Thematic Analysis of the reports from the students and coordinators of partner projects, it was possible to identify evidence of the following soft skills: (i) Problem-Solving/Thinking, (ii) Oral Communication, (iii) Written Communication, (iv) Teamwork/Collaboration, (v) Diversity, (vi) Leadership, (vii) Creativity/Innovation, (viii) Lifelong Learning/Self-direction, (ix) Professionalism/Ethics at Work, (x) Ethics/Social Responsibility, (xi) Conflict Management, and (xii) Communication of Results. Figure 3 illustrates the Sankey diagram obtained in the ATLAS.ti tool, representing the identified relationships between soft skills and the profiles of survey respondents. The width of the arrows in the graph is proportional to the amount of evidence identified during the Thematic Analysis.

More evidence related to lifelong learning/self-direction, professionalism/ethics at work, leadership, and oral communication soft skills was observed. Much of the evidence regarding **Oral Communication** came from the students’ reports, indicating that their actions significantly impacted the development of this soft skill, as did **Lifelong Learning/Self-direction** and **Teamwork/Collaboration**.

Evidence related to **Communication of Results** and **Written Communication** was identified in reports on **Production Scientific** activities by writing abstracts and articles and presenting scientific papers at events and conferences. These skills are crucial for research, education, and science individuals. The ability to write abstracts and articles, present scientific papers clearly and concisely, and adapt language for different audiences is essential to ensure that all understand scientific findings. Below, we offer quotations from some of the soft skills developed by the students. These quotations were from their responses to the question “Can you tell us a bit about how participating in the project has influenced your academic and professional development?”

- **Teamwork/Collaboration:** “Furthermore, the experience of teamwork and knowledge in diversity and gender equality allows me to work well with the team (all men) in the professional environment, knowing that I can learn or develop something regardless of my gender.”
- **Written Communication:** “The project also allowed me to develop scientific work.”
- **Lifelong Learning/Self-direction:** “It also allowed me to learn and use new platforms, new knowledge, and develop my public speaking and social communication.”
- **Oral Communication:** “I am increasingly able to develop myself as a human being, becoming less shy and gaining more confidence in presentations of work/articles.”
- **Results Communication:** “Participating in the project has provided many opportunities to write articles, participate in events, exchange experiences, and disseminate our research.”

Regarding the soft skills developed by coordinators, evidence related to **Diversity** stands out. Individuals who develop this skill can understand and respect differences,

¹¹<https://flourish.studio/>

¹²<https://zenodo.org/>

Table 2. Relevant soft skills for HCI investigated in the Qualitative Analysis.

Soft skill	Description	Source
Teamwork	Collaborative relationship with colleagues; being able to work with diverse teams.	[Ganci and Lahey, 2017; Rosala and Krause, 2019]
Give and Take Feedback	Ability to provide constructive and helpful feedback on others' work and receive feedback on your work without becoming defensive or taking it personally.	[Rose et al., 2020; Ganci and Lahey, 2017]
Communication	Ability to communicate clearly with others, whether in writing, in presentations of work or ideas, or during informal conversations with team members.	[Rose et al., 2020; Ganci and Lahey, 2017; Rosala and Krause, 2019]
Explain Design Decisions	Ability to communicate design decisions clearly to different individuals, in unique formats, and with varying levels of precision.	[Ganci and Lahey, 2017]
Collaboration/Interpersonal	Ability to work effectively with others, not just with members of your own team; interact well with all stakeholders in the project, such as developers, managers, and clients.	[Rose et al., 2020; Ganci and Lahey, 2017]
Empathy	Involves immersing oneself in the users' world, understanding their needs, motivations, desires, and frustrations.	[Ganci and Lahey, 2017; Rosala and Krause, 2019]
Professionalism	Demonstrate personal responsibility and effective work habits.	[Ganci and Lahey, 2017]
Meet Deadlines	Ability to manage the time invested in each activity and be reliable in delivering results.	[Ganci and Lahey, 2017]
Multiple Projects at Once	Work productively on different projects, managing the workload required for each of them.	[Ganci and Lahey, 2017]
Problem Solving	Ability to ask good questions, listen, and obtain relevant information to understand and solve the problem. It also involves articulating what one knows, how one knows it, and how to discover more.	[Rose et al., 2020; Rosala and Krause, 2019]
Storytelling	Ability to develop, express, and adapt stories using various resources.	[Rose et al., 2020]
Handling Conflict	The ability to work with conflicts, seek solutions and work to resolve them.	[Rose et al., 2020]
Persuading Others	Ability to bring people to your way of seeing things, to influence others and the project's direction.	[Rose et al., 2020]
Working with Clients	Ability to work with people external to the company or the work team to manage expectations and achieve project success.	[Rose et al., 2020; Ganci and Lahey, 2017]
Leading	The ability to lead the direction of a project and lead other people within the organization.	[Rose et al., 2020]
Listening/Active Listening	Ability to give others space to explain their ideas, delving deeper through follow-up questions.	[Rose et al., 2020; Rosala and Krause, 2019]
Critical Thinking	Ability to understand a problem and synthesize/analyze existing information.	[Rose et al., 2020]
Creating/Innovating	Ability to approach a problem or situation from a unique perspective.	[Rose et al., 2020]

thus working to create a more inclusive and respectful work environment. There is also notable evidence related to **Ethics/Social Responsibility**, as individuals developing this skill act with honesty, integrity, and fairness.

The coordinators reports identified evidence related to the soft skills **Thinking/Problem Solving** and **Conflict Management**. As with project coordination, these skills are crucial for individuals in leadership and team management roles. The following items provide quotations related to some of the soft skills developed by coordinators. These quotations were obtained from their responses to the question "How does acting in the project coordination influence your academic and professional development?"

- **Ethics/Social Responsibility:** "Understanding the importance of actions to discuss and promote female participation in the ICT field."
- **Diversity:** "In addition, socially, it changed my perspective regarding gender issues in IT, feminisms, intersectionality, among other aspects."
- **Conflict Management:** "Enriches the ability to manage people, conflicts."
- **Professionalism/Ethics in Work:** "Gaining responsibilities and always seeking to do the best, deliver the best to the public."
- **Leadership:** "Coordination influences my learning in leadership and impartiality."

Evidence of the development of **Creativity** was also

found in the reports of both the students and coordinators, emphasizing their ability to communicate new ideas and think of innovative solutions to daily challenges and problems.

Participation in the Digital Girls partner projects significantly impacted the participants' personal and professional development. The projects were also considered an opportunity to develop important skills outside the classroom and engage in extension and research activities. Additionally, many participants mentioned the importance of gender equity and diversity in the technology industry and how their involvement in the project expanded their understanding of these topics.

4.2 Practice of HCI Soft Skills in Partner Projects

With the results from the extended Thematic Analysis of reports from both female participants and project coordinators in partner projects, it was possible to identify evidence of the following soft skills: (i) Teamwork, (ii) Giving and Receiving Critiques, (iii) Communication, (iv) Collaboration/Interpersonal Skills, (v) Empathy, (vi) Professionalism, (vii) Meeting Deadlines, (viii) Working on Multiple Projects Simultaneously, (ix) Problem Solving, (x) Conflict Management, (xi) Persuasion/Convincing, (xii) Leadership, (xiii) Listening/Active Listening, (xiv) Critical Thinking, and (xv) Creativity/Innovation. Figure 4 illustrates the Sankey chart obtained using the Flourish online tool, representing the iden-

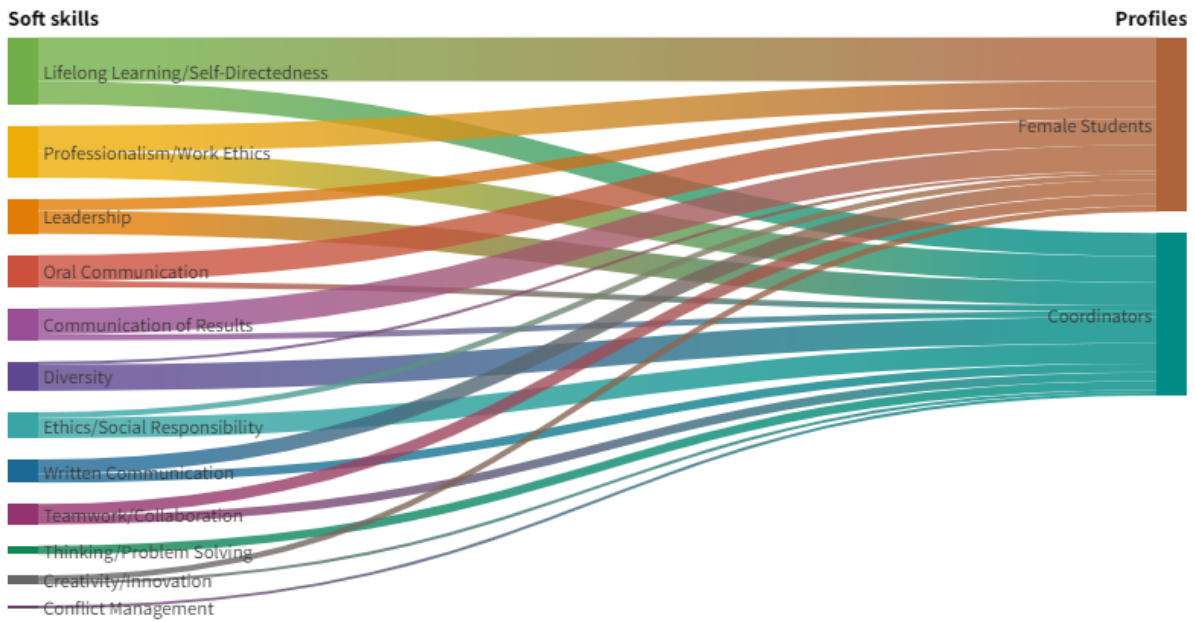


Figure 3. Relationship among Computer Science soft skills and participants' profile.

tified relationships between the soft skills and the respondent profiles in the survey. The width of the chart's arrows is proportional to the amount of evidence identified during the Thematic Analysis.

Much evidence related to Professionalism, Communication, Leadership, and Critical Thinking soft skills were observed. Project coordinators particularly emphasized **Leadership**, while students reported more evidence in **Communication**. Both **Professionalism** and **Critical Thinking** were found in both groups. **Professionalism** indicates that students and coordinators are concerned with refining their techniques through various resources to demonstrate effective work competencies. **Critical Thinking** highlights a concern about the current situation of women in Computing or other sectors in general.

Evidence related to **Collaboration/Interpersonal Skills** was identified in reports describing interaction with partner projects from other regions and professionals in the ICT field, especially for carrying out extension activities. **Empathy** emerges for those in coordinating roles as they seek to understand the challenges students face throughout their undergraduate studies. In the case of students, **Empathy** and **Active Listening** manifest, especially during **Workshops**, when they have the opportunity to engage in dialogue with high school/technical and/or elementary students.

Students often reported the soft skill of **Problem Solving** when mentioning experiences in participating in programming marathons. In these competitions, they are encouraged to seek computational solutions to real-world problems within a limited time frame. **Giving and Receiving Critiques** also appear in the students' reports, as their engagement in partner projects allows them to learn and later pass on their expertise. **Teamwork** is present in both profiles and involves mainly reports of respectful integration into diverse teams.

Evidence of the development of **Persuasion/Conviction** was also found in the students' reports about the ability to

present ideas clearly, adding new perspectives to how others perceive the discussed topic. This ability is very relevant in the **Teamwork** carried out by partner projects, collaborating with colleagues by providing new insights on facilitating **Workshops** and **Lectures**, for example. Below, we offer quotations from some of the soft skills developed by the students.

- **Leading:** "Taking on leadership gave me a different perspective on having and organizing a team for the projects within the project. Besides, the knowledge acquired and passed on to the team members is rewarding."
- **Critical Thinking:** "Since I started participating in the project, I began to realize how important it is for us to be engaged in this subject and the academic community, as this has the power to influence and encourage other students to be part of this team."
- **Collaboration/Interpersonal:** "In college, it provided greater involvement in the academic environment and increased encouragement in my disciplines. Additionally, we constantly share opportunities for scholarships, internships, projects, and courses, further supporting my performance and engagement in the academic community."
- **Empathy:** "It has always been an enriching experience; I have learned a lot from students who participate in the workshops. It has further helped me understand how education is transformative."
- **Problem-Solving:** "I felt more motivated to participate in external competitions and engage with opportunities specifically tailored for women."

Regarding the soft skills developed specifically by coordinators, we have **Creativity/Innovation** in reports about introducing new research themes for the **Scientific Production** of the project, **Meeting Deadlines**, **Conflict Management**,

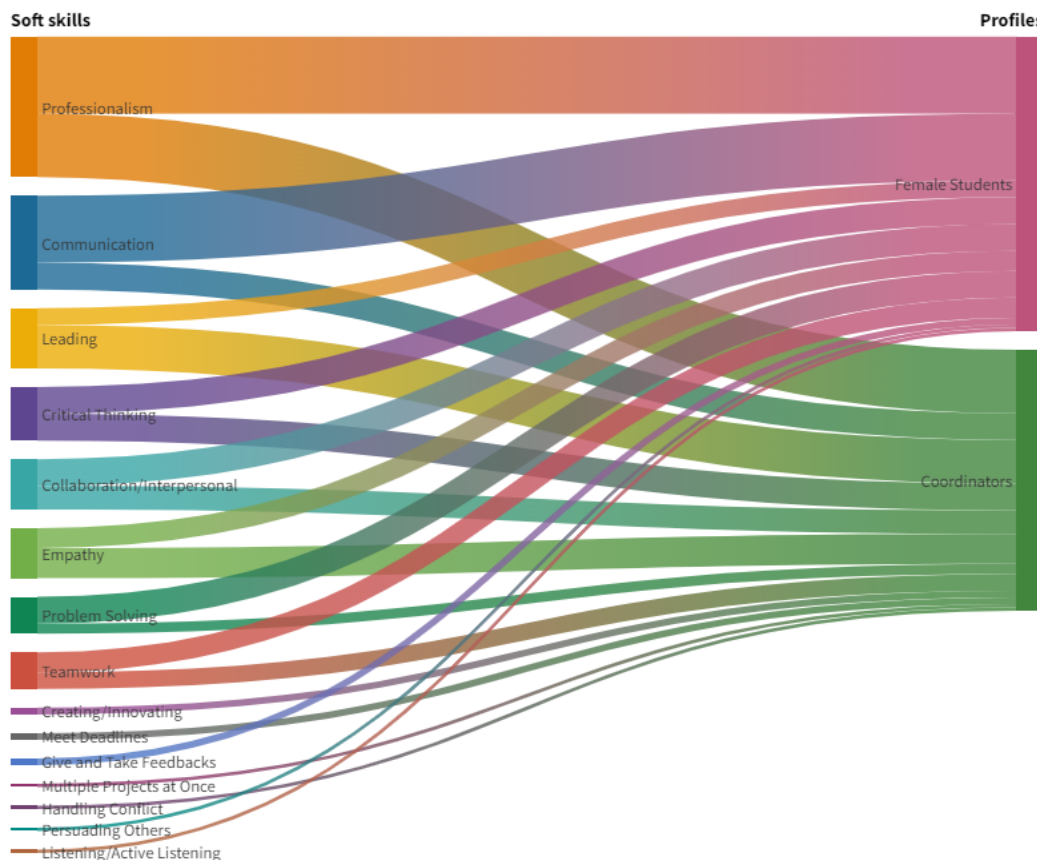


Figure 4. Relationship among HCI soft skills and participants’ profile.

and **Working on Multiple Projects at once** on reports about activity planning. The following items provide quotations related to some of the soft skills developed by coordinators.

- **Creating/Innovating:** “Introducing scientific innovation to the project.”
- **Professionalism:** “Coordinating the project brought me closer to the students, allowing me to understand their learning experiences and challenges during their undergraduate studies. This has been important for becoming a better teacher and has motivated me to research gender in Computer Science.”
- **Empathy:** “I became much more sensitive and attentive when looking at the girls in the course, both on an individual level (as each one has their personal issues) and on a collective level (our actions focus a lot on the sense of group and belonging).”
- **Leading:** “The coordination influences my personal learning regarding leadership and impartiality.”
- **Critical Thinking:** “Professionally, I see the encouragement of gender equity in an area where the most diverse coexistence is essential as extremely important.”

4.3 Analysis of Actions by Partner Projects

The exploratory study of actions allowed us to identify some predominant characteristics in the results. Table 3 shows that all partner projects actively produce content for **Social Media**. The **Workshop** and **Scientific Production** categories

also stand out, with a presence of 89% among the projects participating in the survey.

5 Discussion

With the growth of IT and the unexpected advent of the COVID-19 pandemic, many partner projects found in **Social Media** a way to continue their work. From this perspective, it is possible to observe from Fig. 5 that all projects actively produce content on digital platforms. The most used platforms were Instagram and Facebook, but some projects also use YouTube to share lectures, workshops, and discussions. This context reveals the participant’s ability to engage in **Critical Thinking**, to look at a real-world contingency, synthesize it, and analyze existing possibilities, aiming to find feasible solutions in **Problem Solving**.

To support the presence of girls and women in Computing, the **Workshop** also emerges as a strong ally. This initiative usually takes place outside the academic environment of the projects, aiming to attract female audiences to undergraduate courses or the job market through ICT-related experiences. **Workshops** are usually developed in collaboration with other project members, demonstrating the need to know how to **Work in a Team**, respecting diverse individuals and perspectives. **Communication** and **Active Listening** play an important role in interacting with other students who are making their first contact with the field. Moreover, it is important to mention that more experienced members of the project pass on knowledge and techniques that can be

Table 3. Actions of partner projects organized by category.

Region	Central-West					Northeast						North		Southeast						South									
Project	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	P28	P29
Number of responses	1	1	1	2	2	3	2	1	1	1	2	9	11	1	2	1	1	3	13	2	0	1	3	1	1	2	1	1	3
Social Media	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mentoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Workshops	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Games/Challenges	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lectures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Scientific Production	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 4. Soft skills identified in each Digital Girls’ partner project.

Region	Area		Central-West					Northeast						North		Southeast						South									
Project	CS	HCI	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	P28	P29
Problem-solving	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oral Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Written Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communication of Results	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Communication	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Give and Take Feedback	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Persuading others	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Teamwork	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Collaboration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diversity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Empathy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Listening/Active Listening	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Application of Information Technology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Leadership	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Meet deadlines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Multiple projects at once	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Creativity/Innovation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Lifelong Learning/Self-Directedness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Professionalism/Work Ethics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethics/Social Responsibility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conflict Management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Critical Thinking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

followed to conduct these actions in the best possible way. Everyone involved is prepared to **Give and Receive Feedback** when needed.

Projects also invested in **Scientific Production** to document and share the knowledge and experiences gained in other actions. This activity allows the exchange of learning between projects and contributes to disseminating new ideas

that may reflect the pursuit of gender equity in IT, directly affecting the **Interpersonal Skills/Collaboration** of students and coordinators.

During the Thematic Analysis, evidence of the development of twenty-seven *soft skills* was identified in the partner projects of Digital Girls, which differ in skills useful for Computing, Human-Computer Interaction, or both. Regard-

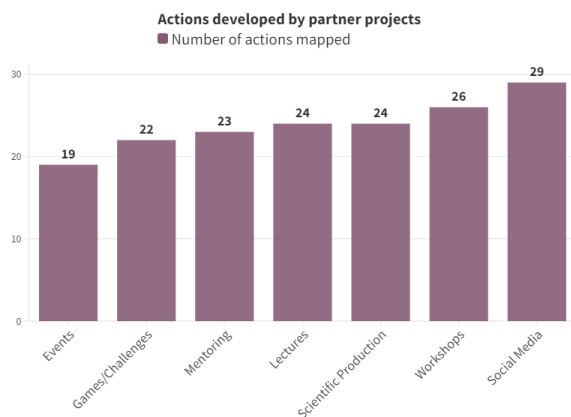


Figure 5. Number of actions conducted by partner projects.

ing common soft skills for Computer Science and HCI, we can highlight leadership, professionalism, and communication. Specifically for Computer Science, we identified self-direction, diversity, ethics, and social responsibility. This underscores the need for specific skills to address ethical and social issues in technology. Critical thinking, collaboration, and empathy were identified as soft skills exclusively in works related to HCI, emphasizing this field's interdisciplinary and user-centered nature.

Some soft skills, such as communication, problem-solving, and critical thinking, have similar nomenclature but different definitions. This justifies gathering more evidence for problem-solving, considering the definition of HCI during the extension of this analysis. It reinforces the need to understand the complexities involved in human interaction and computational systems.

On the other hand, the soft skills base used in the original research details different communication skills, such as oral communication, written communication, and presentation of results. In the HCI soft skills base, communication is a single soft skill, aggregating evidence from all formats of communication developed. The differentiation in communication categories highlights nuances between the soft skills necessary in both fields.

It is important to note that the initial purpose of the survey was not to uncover evidence of specific non-technical skills in the field of Human-Computer Interaction (HCI). Instead, it aimed to understand the effects that the experience of participating in partner projects had on the academic and professional development of the participants. Consequently, new evidence may emerge if a more targeted study focuses on this subarea of Computing.

However, the survey's lack of focus on HCI does not imply the study's irrelevance. On the contrary, soft skills are transferable, meaning that an essential competency in one domain can be applied equally significantly in another, although the manifestation of these competencies may vary. An example of this is **communication**. For computing professionals, it is used in software documentation production, while for HCI professionals, it is used to understand the needs and expectations of users.

Due to the extensionist nature of the partner projects, which actively engage with the communities where they operate, the students and coordinators are directly involved with diverse audiences. This scenario underlies the curios-

ity of this study, which seeks to understand more precisely the profile of the participants for a potential contribution to the field of Human-Computer Interaction (HCI).

Table 4 details the soft skills identified in each partner project that responded to the survey. This identification was based on the information provided by the respondents about the project in which they work. This result indicates that the actions promoted by Digital Girls' partner projects can contribute to developing soft skills in female students and coordinators. These skills are valuable for academic and professional success.

6 Related Works

In this section, we will present works that address the development of soft skills through activities in the field of Computing, emphasizing parity.

To develop non-technical skills, it is necessary to experience practical situations, as they are not acquired solely conceptually. In a qualitative study with postgraduate students, Marques *et al.* [2020] highlighted important soft skills for a Software Engineer, such as teamwork, problem-solving, creativity, and critical thinking. The study used Design Thinking and Software Engineering as methods for the exploratory dynamics.

Passos *et al.* [2021] demonstrated that the Tutorial Education Program (PET) in Maranhão state, Brazil, developed soft skills in participating students. The research used a list of skills required in job vacancies and a collection form to assess students' perceptions. The results were positive regarding communication, empathy, leadership, and teamwork skills, which are demanded in job vacancies.

Rodrigues *et al.* [2022] highlighted the development of interpersonal skills in the members of the Digital Girls of the Valley project, a partner of Digital Girls. Based on the Qualitative Analysis of an internal retrospective, some reflective issues among project members were reported. The experience in the project contributed to the achievement of soft skills required in the professional environment, such as leadership, creativity, communication, and teamwork. Personal skills, such as lifelong learning, self-direction, and problem-solving, were also presented among the members.

Therefore, this work resembles others mentioned in its intention to explore developing interpersonal skills, which are currently necessary and in demand. However, it may differ in focusing on qualitative analysis based on the respondents' profiles and mapping actions from Digital Girls' partner projects.

7 Conclusions and Future Work

This research is an extension of the original study published in Desidério *et al.* [2023], which investigated the development of Computing soft skills in Digital Girls' partner projects. This paper explored evidence related to a specific set of soft skills for HCI in the narratives of women acting as students or coordinators in Digital Girls' partner projects. The adopted methodology was thematic analysis, which al-

lowed the identification of evidence of skills contributing to the personal and professional development of students and project coordinators.

The results indicate that students and coordinators develop leadership, professionalism, and communication skills. These soft skills are relevant for both Computing and HCI. Specifically, concerning soft skills relevant to Computing, there is evidence that students and coordinators develop self-direction, diversity, ethics, and social responsibility. Furthermore, the women's participation in partner projects also develops critical thinking, collaboration, empathy, and specific soft skills for HCI.

These results are expected to contribute to recognizing the actions developed by Digital Girls and partner projects, highlighting their positive impact on the education of students and professionals in the ICT field. The Digital Girls' partner projects are mainly present in higher education institutions. Therefore, participants in partner projects, who develop their soft skills through various actions, have an advantage in transitioning from academia to the industry.

In future work, it is possible to map the potential of different actions in developing specific soft skills. Additionally, investigating the program's influence on other aspects, such as self-esteem and students' expectations regarding technology and career plans in the field, would be valuable.

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