Promoting Digital Culture through Unplugged and Participatory Workshops: An Experience Report with Quilombola Students in the Brazilian Amazon

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Abstract. *Digital culture encompasses practices and forms of interaction mediated by digital technologies; however, limited technological infrastructure remains a challenge in quilombola communities. This paper presents an experience report aimed at fostering digital culture among elementary school students in Oriximiná (PA), Brazil. The study was organized in a station-rotation format, addressing signs, symbols, icons, and visual organization through unplugged computing activities simulating a participatory design process. Data were collected through observations guided by the AEIOU framework. The results indicate engagement, collaboration, and creativity, evidenced in low-fidelity prototypes aligned with students' sociocultural repertoires.*

1. Introduction

Quilombola communities are traditional territories characterized by their own forms of social, cultural, and historical organization, making it essential to consider these specificities when designing educational and technological initiatives for such contexts [de Almeida 2011]. The democratization of access to Digital Information and Communication Technologies (DICTs) still faces geographic and socioeconomic barriers, particularly in traditional territories of the Amazon region [IBGE 2022, CGI.br 2023]. Quilombola communities, for instance, often experience limited technological infrastructure; nevertheless, there is evidence of increasing engagement with digital culture practices, especially mediated by mobile devices [Souza et al. 2021].

In this scenario, Unplugged Computing emerges as a viable methodological alternative for promoting digital culture in contexts with infrastructural constraints [Bell et al. 2011]. By decoupling learning from the direct use of computational devices, this approach shifts the focus toward developing critical thinking, creativity, and problem-solving skills, key competencies for 21st-century education [Silva et al. 2020]. From a Human-Computer Interaction (HCI) perspective, this view enables an understanding of interfaces as systems composed of signs and symbols that require processes of decoding and reinterpretation according to users' cultural repertoires [de Souza 2005]. Thus, Unplugged Computing, through an HCI concept, represents a promising strategy for strengthening digital culture in quilombola communities.

Therefore, this paper presents an experience report on workshops grounded in Participatory Design (PD) conducted in an unplugged, station-based format with elementary school students from the quilombola communities of Bacabal and Aracuan do Meio, in Oriximiná, Brazil. The choice of PD aimed to place students at the center of the educational experience, encouraging active participation, collaboration, ownership, and the collective construction of knowledge. The PD was adopted as an educational strategy to support learning experiences through culturally situated, and collaborative practices.

The workshops involved 16 elementary school students, accompanied by two teachers and seven guardians, and were facilitated by seven undergraduate HCI students from the Federal University of Western Pará (Ufopa), Oriximiná Campus (Cori). The experience sought to promote the understanding of semiotic aspects, such as icons, colors, and spatial organization, by directly relating them to participants' daily lives, fostering digital culture through the appreciation of local knowledge.

Data were collected through observation using notes inspired by the AEIOU ethnographic framework [Wasson 2000]. The findings indicate that a central challenge lies in the cultural distance between conventional digital interfaces and Amazonian repertoires, which are often overlooked. As a contribution, the experience demonstrates the potential of PD to foster creativity and autonomy by reinterpreting icons based on local fauna, flora, and knowledge systems, suggesting that digital literacy in these territories extends beyond technical skills to encompass affirming quilombola identity.

2. Background

Promoting digital culture in school settings requires developing competencies that go beyond the instrumental use of technology to encompass critical engagement with digital languages, representations, and practices. In Brazil, the National Common Curricular Base (BNCC) recognizes digital culture as a core competence in Basic Education, emphasizing the ethical, critical, and meaningful use of DICTs across diverse sociocultural contexts [Brasil 2018]. In the context Quilombola, digital culture is understood as access to digital technologies and social practices involving the interpretation, creation, and reinterpretation of digital representations in accordance with local sociocultural realities and forms of digital literacy [Velloso 2015]. This perspective includes visual literacy and interpretative abilities essential for understanding interfaces and digital systems.

Literacy refers to social practices that enable participation in literate and consequently digital cultures [Soares 2002]. In the context of computing and interfaces, this involves recognizing, interpreting, and producing icons, symbols, and visual structures. In traditional territories, such as quilombola communities, these practices must account for historical and cultural specificities, requiring culturally responsible computing education strategies aligned with local realities [de Almeida 2011].

In the Amazon region, where connectivity and technological infrastructure remain significant limitations [CGI.br 2023], promoting digital culture demands pedagogical approaches that do not rely solely on access to computers or the internet. Thus, Unplugged Computing provides an equitable alternative by introducing foundational computing concepts through collaborative, playful, and tangible activities without digital devices [Bell et al. 2011]. Beyond computational thinking, unplugged approaches can foster interpretative and representational skills that are central to digital culture [Silva et al. 2020].

From a HCI perspective, unplugged activities enable reflection on interaction and interface design. Semiotic Engineering conceptualizes interfaces as a metacommunication process between designers and users, structured through signs and symbols that require cultural interpretation [Barbosa et al. 2021]. This perspective reinforces the importance of helping learners understand how digital artifacts communicate meaning. Communicability refers to the interface's ability to convey its intended message clearly; breakdowns occur when users fail to interpret this communication adequately [de Souza 2005].

Finally, PD recognizes learners as experts in their own sociocultural contexts [Winschiers et al. 2025]. This approach strengthens computing education initiatives by valuing local knowledge and enabling students to co-create representations and prototypes that reflect their lived experiences. By integrating Unplugged Computing and PD, it becomes possible to promote digital culture in culturally situated, infrastructurally constrained contexts, thereby contributing to more inclusive educational practices.

3. Related Work

Considering that this experience report presented unplugged workshops from an HCI perspective with elementary school children from a quilombola community in the Lower Amazon region, we identified studies that developed computing education activities in Amazonian contexts, particularly in traditional communities or socially vulnerable settings, in order to identify convergences and gaps in relation to the present proposal.

Soares et al. (2025) describe an experience focused on functional digital literacy with students from traditional communities. The intervention, conducted in a university setting, aimed to address difficulties in the use of basic digital tools. The results revealed weaknesses in these competencies and highlighted the need for culturally sensitive programs. Dolzane et al. (2025) report a professional development initiative for riverine teachers that introduces Computational Thinking concepts through Unplugged Computing. The workshops, conducted without computers, received a positive reception and showed potential applicability in local pedagogical practices.

Silva et al. (2020) implemented unplugged activities with elementary students, focusing on logical reasoning and problem-solving in the mathematics course. The findings indicated student engagement and the methodological feasibility of unplugged approaches in contexts with technological constraints. More closely related to the present proposal, Almeida (2022) investigated the introduction of HCI concepts in elementary education through unplugged activities, including interface element identification and low-fidelity prototyping, with active student participation inspired by PD. The study demonstrated that HCI concepts can be adapted playfully for young learners.

Unlike these studies, our study integrates Unplugged Computing, HCI, and PD within an Amazonian quilombola context. It does not focus solely on Computational Thinking, as in Silva et al. (2020) and Dolzane et al. (2025), nor exclusively on functional digital literacy, as in Soares et al. (2025). Although it engages with Almeida (2022), it differs in its emphasis on placing territory and local culture at the center of activity design. No prior studies were identified that simultaneously integrate unplugged HCI, elementary-level children, and an Amazonian quilombola context. Therefore, this work contributes to expanding the scope of Unplugged Computing by incorporating HCI and PD principles into a culturally situated experience in the region.

4. Methodology

This experience was conducted in the quilombola community of Bacabal, with the participation also of students from the Aracuan do Meio school in Oriximiná, Pará, Brazil. The workshops were part of the InovaEPP project (Innovation, Extension, Prototyping, and Community Participation). They were facilitated by seven sixth-semester undergraduate students enrolled in the HCI course of the Bachelor's degree in Information Systems (BSI), including one male and six female students, two of whom self-identify as quilombola. The connection with the community was established through an invitation initiated by the quilombola university students themselves, aimed at sharing knowledge developed in the academic context and contributing to local community needs. The workshops were supervised by three faculty members from the BSI program: the HCI course instructor, a professor in Innovation and Entrepreneurship (also the program coordinator), and a professor in Mathematics (coordinator of the university extension laboratory).

The initiative involved 16 elementary school students (aged 7 to 11) from two quilombola schools, accompanied by two school teachers and seven guardians. Student participation occurred as part of regular school educational activities, with no individual data collection or personal identification. Ethical considerations are detailed in Section 6. The workshops were inspired by the Unplugged Computing approach [Bell et al. 2011] and organized using a station-rotation model. Station rotation is an active learning methodology in which students move among different stations to engage in varied learning experiences and collaboratively construct knowledge [Fulbeck et al. 2020].

This structure enabled the exploration of key HCI concepts addressed in the BSI course, including: (i) PD to encourage students to collaboratively discuss ideas and co-create representations connected to their local culture; (ii) Information Architecture, related to the logical organization of content and visual elements; (iii) Communicability, understood as the ease with which users can interpret and perform actions proposed by an interface; (iv) Low-Fidelity Prototyping, involving the tangible materialization of interfaces using paper, pens, and recycled materials. Students were encouraged to design, interpret, and manipulate paper prototypes, fostering the understanding of interaction concepts in a simple, concrete, and culturally situated manner. This paper is structured into planning, implementation, and analysis phases.

4.1. Study Planning

Initially, logistical strategies were defined to ensure the organization and implementation of the workshops, with the aim of fostering participant engagement. The planning phase included a preliminary visit to the community to understand the local context, followed by a formal invitation to the school's teachers. This collaboration made it possible to define dates, times, and spaces for the activities, taking into account the school's context, the students' age groups, classroom routines, and community dynamics. Given the territory's specific geography, river transportation was required, with an estimated travel time of approximately 3 hours from the municipal center of Oriximiná. This required prior transportation planning and careful scheduling. The workshops were planned for the morning, with an estimated duration of 4 hours and a scheduled break.

The workshops were designed to promote digital culture by encouraging interest in computing through playful, participatory, and unplugged approaches. They were

structured to foster creativity, empathy, and collaboration, enabling the understanding of digital and interaction concepts without the use of electronic devices. The workshops followed a station-rotation format [Farias and Santos 2023] to simulate a PD process. Each station corresponded to a stage of the creative process, including ideation, persona creation, experience enactment, and prototyping, ensuring that all participants engaged in the full cycle of idea development, from initial conception to low-fidelity prototype creation. A large open community space was selected in advance to accommodate the activities.

4.2. Study Execution

The first station, entitled "Draw and Discover: What Is on the Screen?", aimed to stimulate curiosity about interfaces and foster idea generation. The activity was divided into two moments. First, a brief introduction was provided, and participants were organized into groups (four trios and one group of four), which remained the same throughout the subsequent stations. A diagnostic question ("Who uses a mobile phone?") was posed to identify students' familiarity with digital devices, followed by the presentation of printed drawings of common interface icons. In the second step, teams pasted images of interface buttons onto a rectangular piece of cardboard previously labeled with some icon names, matching each symbol to its corresponding term, as shown in Figure 1. After this, correct matches were counted. The station concluded with a group discussion on everyday screen use, encouraging reflection on the digital interfaces in participants' daily lives.

Figure 1. Students identifying and matching interface icons.

Figure 2. Students presenting their created characters.

The second station, "Hero Character: Creating Your Personal Protective Equipment," was designed to foster identity, creativity, and empathy through persona creation [Nielsen 2013]. Participants created heroic characters and crafted accessories such as masks, glasses, lab coats, and headbands using materials including paper, foam sheets (EVA), fabric, markers, glue, glitter, crayons, adhesive tape, and safety scissors. The proposal invited students to imagine heroes committed to the well-being of their communities. Each participant defined the character's name, superpowers, and mission. At the end of the station, students presented their characters to their peers, describing their abilities and reflecting on how they could contribute to their community (Figure 2).

The third station, titled "Living Maze: You Are the Character!", featured a board game designed to promote interactivity, collaboration, and collective decision-making.

Ten cards of each color were prepared, corresponding to different challenge categories (Figure 3). The maze included a path of 40 colored squares arranged in alternating colors. The squares were printed on A4 sheets, covered with adhesive tape for durability, and fixed onto TNT fabric to form the base of the course (Figure 4). Each team selected one representative to move along the board and complete tasks on the group's behalf. Progress was determined by rolling a large cardboard die, which indicated the number of squares to advance. Each color represented a specific type of challenge: blue squares included questions reviewing previously covered content; green squares proposed physical challenges involving movement and balance; yellow squares stimulated imagination and creativity; purple squares contained surprise cards with effects such as advancing, moving back, or performing collective actions; and red squares presented challenges requiring attention, self-control, and cooperation to avoid returning to the start or losing a turn. When landing on a colored square, the representative drew the corresponding card and completed the indicated task. Successful completion allowed the team to continue in the game.

Figure 3. Cards Used in the Maze of Rotation Three.

Finally, the fourth station, "Magic Screen: Prototyping Your App or Game," enabled the consolidation of previously acquired knowledge by creating unplugged prototypes, i.e., physical models simulating digital interfaces without electronic devices, as shown in Figure 5. Students used cardboard mobile phone templates to organize and attach screens drawn on A4 sheets. They were guided to design a game set in their own community, applying concepts of buttons and interactions introduced in the first station, including movement commands (forward, backward, and jump) and screen navigation. Additionally, they incorporated the character developed in the second station as the protagonist of the game narrative, integrating the character's traits, abilities, and mission into the storyline and proposed functionalities.

4.3. Data Collection and Analysis Methods

Data were collected through observation of the workshops. To ensure methodological rigor and systematic documentation, the AEIOU framework [Wasson 2000] was employed to organize observations into five dimensions: (a) **Activities**: tasks performed by participants, such as icon creation and navigation through paper prototypes; (b) **Environments**: characteristics of the community physical space and their influence on workshop dynamics; (c) **Interactions**: forms of peer collaboration and communicative exchanges during the workshops; (d) **Objects**: materials used and visual signs produced throughout the activities; and (e) **Users**: participants' perceptions, behaviors, and experiences.

Figure 4. Students participating in the human board game activity.

Figure 5. Students presenting their unplugged app and game prototypes.

Qualitative data were analyzed using Content Analysis [Drisko and Maschi 2016], following three stages: (a) pre-analysis, (b) material exploration, and (c) treatment of results. The pre-analysis phase involved organizing and conducting an initial reading of the observation records. During the material exploration, data were coded according to recurring patterns observed in the workshops. In the final stage, synthesis, inference, and interpretation were conducted to identify strengths and challenges of the workshops within the quilombola community context. Data analysis was supported by Atlas.ti[1] (version 7). The coding and categorization process was conducted by one researcher and reviewed by a second researcher, with consensus established in cases of disagreement.

5. Results and Discussion

The qualitative analysis aimed to understand how Unplugged Computing, articulated through a PD process, contributed to promoting digital culture in the investigated context. To preserve anonymity and ensure ethical rigor, quotations from the observations were coded as Q1-Q11. The analytical process yielded four categories, as presented below.

Regarding interaction and collaboration dynamics, the findings indicate that unplugged activities mediated the transition from everyday device use to a more critical reading of digital interfaces. Although students reported frequent mobile phone use, they initially struggled to identify interface icons and buttons.

"At first, the students reported frequent access to mobile phones. However, even though they used these devices daily, they were unable to identify the icons and buttons presented." (Q1)

"Throughout the activity, they gradually understood the meanings and began recognizing each symbol more easily." (Q2)

"The students were able to transform what they learned into something concrete, creating physical representations with hands-on materials." (Q3)

These accounts suggest that access to devices does not automatically translate into digital literacy. The initial difficulty in recognizing icons indicates that instrumental use

[1] https://atlasti.com/

of DICTs does not guarantee understanding of their symbolic logic. From a Semiotic Engineering perspective, interfaces can be understood as designer-encoded messages that require interpretative repertoires for proper comprehension. In this sense, the structured unplugged activities helped to make abstract interface concepts tangible, thereby enhancing students' perceived communicability.

About the development of 21st-century skills, collaborative dynamics emerged as a transversal element across all stations. Students spontaneously adopted collective strategies to deal with uncertainty (Q4 and Q5) and provided informal peer support (Q6).

"Students actively participated, exchanging ideas and helping one another. Everyone contributed to successfully completing the activity." (Q4)

"Students communicated constantly, debating the images; when unsure, they decided to leave that image for last." (Q5)

"Some teams demonstrated greater ease, while others required support to correctly identify the icons." (Q6)

The absence of conflict and the presence of spontaneous cooperation were consistent throughout the observations, indicating that the welcoming environment and small-group format fostered socially situated learning. Externalizing design reasoning through discussions about element organization and shared decision-making contributed to collective meaning-making.

Regarding technological appropriation and digital culture, some students spontaneously incorporated elements of their own territory into their creations (Q7 and Q9), while others represented their heroes as socially impactful community members (Q8).

"It was possible to perceive the affective bond with the territory, as many used community elements such as the river, forest, and school in their prototypes." (Q7)

"Students created not only superheroes but also community characters. Many emphasized that they wanted to create heroes who truly help." (Q8)

"All the characters created aimed to help the community in some way." (Q9)

These findings indicate that students' community awareness was primarily expressed through symbolic and imaginative dimensions. The incorporation of territorial elements into prototypes demonstrates that technological learning was reinterpreted through local sociocultural experiences. This articulation reinforces the relevance of culturally situated methodologies, particularly in quilombola contexts, where territory plays a structuring role in identity formation and collective belonging.

Finally, regarding identity, territory, and technological engagement, a key challenge observed was student disengagement during sequential participation activities (Q10), which was mitigated by overlapping station activities (Q11).

"At one point, students seemed to find the activity boring due to waiting for others to search for cards and respond." (Q10)

"It was necessary to start Station 3 simultaneously, which quickly restored students' engagement." (Q11)

This episode highlights the importance of pacing and simultaneity in active

methodologies, particularly in groups with age diversity. For future iterations, it is recommended to (a) restructure sequential activities to ensure continuous participation; (b) extend time allocated to creative stations; and (c) incorporate structured verbal reflection moments to complement the symbolic expression demonstrated by students.

Overall, the findings indicate that integrating Unplugged Computing and PD from an HCI perspective expanded students' semiotic understanding of interfaces, strengthened collaborative competencies, and valued cultural identity in the technological creation process. Promoting digital culture in Amazonian contexts, therefore, extends beyond expanding access to DICTs; it involves creating conditions for critical interpretation, authorship, and recognition of territory as a legitimate reference in digital artifact production.

6. Ethical Considerations

The study adheres to the ethical principles applicable to educational initiatives conducted in traditional communities. The project originated from an invitation from a female student in the HCI course and a community resident, who mediated the entire process. An initial visit was conducted to present the project, clarify its goals, align expectations, and engage in dialogue with school administrators, community leaders, and guardians. This step was essential to ensure transparency, active listening, and respect for local dynamics. Engagement with the community occurred through dialogue, with support from both quilombola and non-quilombola university students, thereby recognizing cultural specificities and strengthening the relationship between the university and the community.

The workshops were conducted in the school environment, with support from the community center and the approval of school management and students' guardians. The activities were exclusively educational. No personal data or sensitive information related to traditional knowledge was collected. The analyses presented in this article are based solely on observations of the workshops and collective interactions that occurred during the activities. Participants' anonymity and confidentiality were fully preserved, and no identifying information was disclosed. The study aimed to provide formative experiences for undergraduate students in BSI, focusing on applying HCI concepts in a community context.

7. Limitations and Lessons Learned

This study has limitations arising from its exploratory and short-term nature. The intervention took place on a single day, which prevents longitudinal follow-up and the analysis of medium- and long-term impacts. The number of participants was lower than initially expected due to logistical constraints typical of the Amazonian region, such as river transport and family commitments, although children from two nearby communities were able to participate. Dependence on boat transportation also created unforeseen mobility challenges for the research team, posing an external threat to the execution. From a methodological perspective, data collection relied on structured observation guided by the AEIOU framework. Evaluation was based on observations of group dynamics and final presentations, without the use of standardized instruments or pre- and post-intervention comparisons. The absence of formal metrics and the lack of systematic analytical assessment of the prototypes represent internal threats to validity. Additionally, the active presence of undergraduate facilitators may have influenced children's engagement levels.

Despite these limitations, the station-rotation structure proved suitable for the age diversity of participants, supporting gradual conceptual progression. The prototyping station stood out as a key moment for consolidating learning, demonstrating creativity, collaboration, and strong connections to the local territory. The creation of personas reinforced cultural identification and highlighted the potential of PD in community-based contexts. Regarding areas for improvement, the maze station would benefit from adjustments to enable greater simultaneous participation. Difficulties were also observed in icon recognition, particularly when the icons were associated with English terminology. Future initiatives should therefore incorporate more structured evaluation instruments and provide clearer contextualization of technical terms. Overall, the experience suggests that unplugged practices from an HCI perspective are viable in traditional communities when they are culturally situated and methodologically sensitive to territorial specificities.

8. Conclusions and Future Work

This paper presents an experience report about disconnected workshops in quilombola communities of Bacabal and Aracuan do Meio, located in Oriximiná, Pará, Brazil. The study focused on promoting digital culture by examining the semiotic aspects of digital interfaces, accounting for the sociocultural specificities of the community context. By integrating Unplugged Computing, HCI principles, and PD, the initiative sought to foster culturally situated and inclusive practices in computing education.

The findings indicate that the unplugged approach fostered participant engagement, encouraged collaborative learning, and enabled the construction of meanings about digital technologies grounded in local everyday references. The workshops supported students in reflecting on icons, symbols, colors, and the visual organization of interfaces, reinforcing the notion of the interface as a communicative message.

The use of DP with unplugged activities and low-cost materials suggests that these practices can be adapted and replicated by teachers in school settings with limited technological infrastructure, contributing to the sustainability of digital literacy initiatives in elementary education, promoting student-centered collaborative learning experiences in computer science education, strengthening the relationship between the university and the community, and fostering more inclusive and culturally sensitive educational processes.

The experience also contributed to the professional development of the undergraduate students involved, enabling them to apply HCI concepts in a real-world context. This expanded their understanding of the social role of technology and the importance of educational practices that are sensitive to inequalities in access to digital technologies. As future work, we suggest expanding the initiative to other communities to deepen the analysis of Unplugged Computing's impacts on digital culture. Further research should also explore strategies that integrate unplugged and connected activities and develop structured assessment instruments to examine, in the medium and long term, the effects of these practices on participants' digital literacy and agency.

Availability of Artifacts

- `https://doi.org/10.6084/m9.figshare.31428266`

Statement on the Use of Artificial Intelligence

This study was supported by the Artificial Intelligence (AI) tool Claude, which provided methodological assistance with the qualitative analysis process. Claude was used to support data organization, the systematization of analytical categories, and the textual refinement of interpretations, contributing to greater structural clarity and interpretative rigor. However, the process was peer-reviewed, with the support of the project supervisor.

Additionally, the tools Gemini and GPT were used in some sections exclusively for textual adjustments and refinements, including language revision, clarity, and fluency improvements in English. Therefore, these tools did not conduct the analysis, produce theoretical interpretations, or participate in the study's conceptual construction; they served solely as linguistic support.

All analytical decisions, theoretical interpretations, and conceptual validations remained under the exclusive responsibility of the researchers. The use of AI tools served as technical support and did not replace critical analysis, scientific judgment, or the theoretical foundation developed by the authors.

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