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Design of Data Literacy Assets-based Learning Strategies with Marginalized Communities Inspired by Paulo Freire's Pedagogy

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Abstract. This article presents the design of an ethnographic investigation through action research to propose a participatory educational design for teaching and learning data literacy (DL). We were inspired by the Paulo Freire method, which is collaborative in its philosophy and design. The proposal unites universities, social movements, public authorities, and territories through stages of culture circles. Asset-based design will be the epistemological approach for building and evaluating a learning method. The culture circles will occur in Complexo do Alemão Favelas, Rio de Janeiro, and may be extended to other communities.

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1 Introduction

We all create data daily, which is collected, counted, and computed on a massive scale by institutions (Lupi and Posavec, 2016). The volume of data in the world is increasing because information detection devices have become cheap and numerous and because the world's capacity to store information has practically doubled every 40 months since the 1980s (NATIONS, 2023). However, even with evidence of the need to talk about data and its impact on our lives, we still need an education aligned with the social needs of the data-driven world. Meanwhile, 4 out of 10 Brazilians receive fake news daily (Brasil, 2022), technologies that claim to be scientific reinforce racism and other forms of injustice (Benjamin, 2023), surveillance systems are implemented without us having control over our privacy (Snowden, 2019), and social media algorithms possibly impact the population's mental health (Faelens et al., 2021).

Society's difficulty in dealing with data can undermine democracy, facilitating the rise of fascism around the world, in addition to increasing the social contradictions generated by capitalism (Chomsky, 2005; País, 2018; Guardian, 2018; Post, 2023; Braziliense, 2023; Notícias, 2019; Brito et al., 2023; Castro-Gómez and Grosfoguel, 2007; Mignolo, 2007). In this reality, in which marginalization imposes everyday microaggressions and the development of systems that subjugate entire groups of people (Liang et al., 2021), an argument in favor of mass Data Literacy (DL) teaching is to enable citizens to interpret, understand, and use data effectively to maintain transparent and accountable governments (Bhargava et al., 2015). DL can help civil society catalog rights and violations, feed data-based journalism, and encourage citizen engagement in anti-corruption efforts. Furthermore, increasing DL can help overcome the digital divide problem (Bhargava et al., 2015).

Educational Design carries out educational projects (Shackelford and Weekes-Shackelford, 2021). The principles of Educational Design derive from knowledge about human cognition and are related to secondary knowledge (Geary and Berch, 2016), which organizes knowledge into biological or evolutionary and primary knowledge. Humans evolved to acquire primary knowledge of listening to and speaking a native language, for example, which tends to be acquired automatically (Shackelford and Weekes-Shackelford, 2021). We can acquire secondary knowledge, but we have not specifically evolved this, so we need conscious effort to acquire it. An example of secondary knowledge is solving a simple equation, for which we must possess the primary-generic problem-solving strategy. However, we need to go further and learn domain-specific solving tactics offered explicitly.

The main objective of this research is to build strategies to support DL learning with actors from historically marginalized territories. Other objectives are: 1) expand the voice of the territories so they can show their demands to the

government and society; 2) encourage the strengthening of social networks and collaboration between favela and university data collectives; 3) design educational resources for teaching and learning DL; 4) provide means for implementing public policies related to DL in Brazil.

The question of this research is: How can we create DL teaching-learning methodologies and strategies, based on the Paulo Freire method and community assets in the favelas, to expand voices in the search for their rights?.

2 Related Work

As works related to this research design, we present some references relevant to the use of Asset-based Design Approach in the context of CSCW research (subsection "CSCW and Asset-based Design") and DL education through the Popular Education philosophy (subsection "Data Literacy and Popular Education").

2.1 CSCW and Asset-based Design

HCI and CSCW researchers have explored teaching DL to citizens for engagement and civic interaction (D'Ignazio and Bhargava, 2016; D'Ignazio and Bhargava, 2020; Johnson et al., 2021), emphasizing ethical paths (Shapiro et al., 2020), equity, decolonization, sustainability (Bentley et al., 2023), feminism (D'Ignazio and Klein, 2023), and well-being (Oman, 2021) in data teaching. In other contexts, they have provided methodological paths for community-based projects (Taylor et al., 2013; Balestrini et al., 2014, 2015). Sharing this perspective, asset-based design is a design approach that seeks to meet the communities' needs by discovering their potential towards the participatory development of sustainable solutions (Wong-Villacres et al., 2021; Cho et al., 2019).

The Asset-based Design Approach centers on individuals' and communities' existing potential (Wong-Villacres et al., 2021). In HCI and CSCW, assets-based design aids immigrants (Cho et al., 2019; Wong-Villacres et al., 2021) and human trafficking victims (Wong-Villacres et al., 2021). Asset-based Design key steps include knowing when to use it; identifying assets; amplifying voices; aligning assets with goals; and envisioning new futures (Wong-Villacres et al., 2020b). Intersectionality is crucial, addressing gender, race, ethnicity, language, and economic factors like low income (Cho et al., 2019).

Assets-based design utilizes various resources, from institutional to intangible like knowledge, care, solidarity, cultural values, social networks, and local knowledge (Hui et al., 2020; Wong-Villacres et al., 2020b; Mills et al., 2019; Roldan et al., 2019; Karusala et al., 2017; Ismail and Kumar, 2018; Wong-Villacres et al., 2020a; Cho et al., 2019; Dickinson et al., 2019; Karusala et al.,

2019; Pei and Nardi, 2019). This approach aligns with a CSCW perspective, offering support first in the social, then technical areas.

3 Data Literacy and Popular Education

Popular education is politically significant and driven by a liberating pedagogy. It empowers individuals to question existing ideologies and fosters continuous learning and unlearning (Jara, 2010). We mapped literature on DL learning experiences through the Popular Education lens. DL learning based on the concept of Popular Education encompasses skills for data use and critical production, including reading, processing, communicating, and producing data (Tygel and Kirsch, 2016).

Developing DL research alongside Popular Education is crucial given societal structures that perpetuate social disparities through exploitation and marginalization based on factors like race, gender, sexual orientation, and colonial history (Mignolo, 2007; Castro-Gómez and Grosfoguel, 2007). DL rooted in Popular Education (Tygel and Kirsch, 2016) stems from Paulo Freire's Pedagogy (Freire, 1971, 2014; Lyra, 1996), which integrates the political and pedagogical dimensions (Machado, 2022), viewing literacy not just as technical skill acquisition but as a path to emancipation (D'Ignazio, 2017).

Employing the PICOC protocol (Petticrew and Roberts, 2008) and defining search parameters, we explored Google Scholar, Scopus, IEEE Xplorer, and SciElo databases, yielding 102 publications, including articles, book chapters, and theses from 2015 to 2022.

The study revealed four strategies for DL education. The most hegemonic, through the dialogue between science and art (D'Ignazio, 2017; D'Ignazio and Bhargava, 2020; Markham and Pereira, 2019; Stornaiuolo, 2020; Bhargava et al., 2016; Xie, 2018; Bhargava and D'Ignazio, 2015; Raffaghelli, 2022; Vacca et al., 2022b; Matuk et al., 2022; Vacca et al., 2022a). The second most used approach was based on real-world scenarios without the aid of art (Peer, 2019; Fotopoulou, 2021; Verständig, 2021). Other research (Verständig, 2021; D'Ignazio, 2017; D'Ignazio and Bhargava, 2016; Johnson et al., 2021; Bay and Atherton, 2021; Tygel, 2016; Hadzigeorgiou and Hadzigeorgiou, 2016) were inspired by practices based on epistemologies/ideologies/philosophies. Moreover, Tygel and Kirsch (2016) took a theoretical approach.

In the science and art approach, the types of art for student engagement were muralism (D'Ignazio and Bhargava, 2020; Bhargava et al., 2016), theatrical performance (D'Ignazio and Bhargava, 2020; Markham and Pereira, 2019), printmaking (Stornaiuolo, 2020), photography (D'Ignazio, 2017; Matuk et al., 2022), jewelry (D'Ignazio, 2017), audiovisual (Xie, 2018), music (Bhargava and D'Ignazio, 2015), sculpture (Raffaghelli, 2022), comics (Vacca et al., 2022b; Matuk et al., 2022), dance (Matuk et al., 2022), collages (Matuk et al., 2022), and

memes (Vacca et al., 2022a). Integrating science and art fosters holistic learning experiences, aligning with popular education's ethos. Both fields value creative imagination, which can transform reality perception and inspire attitudes toward life and its complexities (Hadzigeorgiou and Hadzigeorgiou, 2016).

The proposal of this research differs from the works presented in the mapping because it is inspired by Paulo Freire's culture circles for the collaborative construction of learning strategies with universities, territories, and public authorities, taking advantage of the positive features and potential found in territories and peer collaboration through Assets-based Design Approach.

4 Methods

We will conduct an ethnographic study through action research using asset-based participatory design. The analysis method will be qualitative and quantitative, as recommended in the literature for discovering knowledge in Human-Computer Interaction (HCI) (Sharp et al., 2019; Lazar et al., 2017). The research methodology comprises steps defined by the research team and community interaction.

The steps pre-defined by the research team are: 1) Identification of the problem within its context; 2) Systematic mapping about DL learning experiences based on the concept of Popular Education; 3) Holding and participating in Human-Data Interaction workshops to foster the emerging Brazilian community in the area; 4) Submission of the project to the research ethics committee; 5) Participating in a service learning project involving UFRJ's community, public authorities, and local territories to conduct ethnographic research, action-oriented projects, and workshops with community actors; 6) Participatory design of the DL learning strategies; 7) Design of artifacts and educational resources; 8) Evaluation of results together with the community and experts; 9) Systematization of results. Step 4 has already been completed, and step 5 has begun.

4.1 Workshops Evaluation

The evaluation of the workshops will consist of assessments carried out before and after each activity through written tests, interviews, direct observation of participants' behavior, and notes of situations experienced during ethnography and action research. In addition, there will also be conversation circles with participants to evaluate the results and plan new steps. At the end of the collaborative work with the community, the methodology created, the derived artifacts, and other results will be submitted to experts in the areas of knowledge that make up DL in the complexity achieved during ethnography.

5 Design of the data literacy learning strategies

The design of the learning methodology will be participatory with the Nave do Conhecimento of Nova Brasília - Complexo do Alemão, Universidade do Rio de Janeiro, and Rio de Janeiro City Hall in at least two cycles of Design Science Research (DSR) (Fig.1). The first cycle is inspired by the Paulo Freire method and his culture circles, conducted through the action research method, in which the researcher and the community negotiate the activities carried out in the workshops.

The second cycle will involve workshop activities with Nave partner communities to improve the strategies. We expect that there will be a third cycle of improvement with social movement collectives. After the cycles end, the method will be evaluated with experts and groups collaborating in the design process.

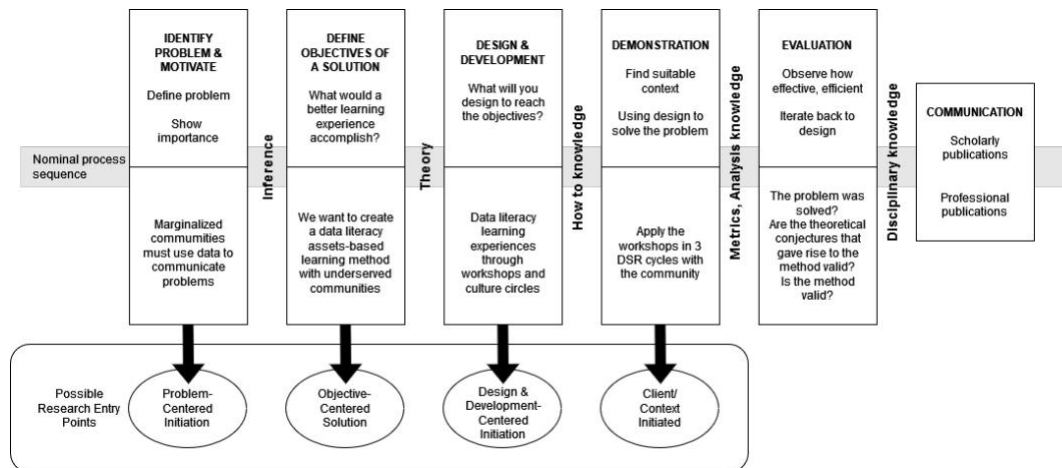


Figure 1. Design science research methodology Process Map by Ken Peffers and Chatterjee (2007).

5.1 Culture circles for data literacy

The preliminary design of the method described in steps 5 and 6 (Methods), and the first DSR cycle mentioned in section 4, follows the inspiration of the Paulo Freire method in its stages. It takes place in 4 joint efforts: 1) Community outreach: to initiate contact with participants to establish bonds of trust and achieve partnerships; 2) Coding phase: to explore the generating themes that will give impetus to discovering the subjects that the community wants to address in the workshops; 3) Culture circles: to make the thematic delimitation; 4) The data literacy campaign: to express participants' thoughts about the reality in which they live while the educator problematizes the issues raised by the group.

When writing this article, we are finishing the first joint effort. In the second, a photovoice workshop (Lu et al., 2023; O’Leary et al., 2021) will be held, in which culture circles will find topics of interest to the community for discussion about data.

5.2 Expected results and contributions

The expected contribution of this research is a learning environment with activities and educational resources aimed at learning DL. This environment will mainly focus on helping vulnerable communities obtain the knowledge necessary to claim their rights as citizens through collection, management, analysis, and argumentation through data.

6 Conclusion

Based on the Paulo Freire method, we propose creating DL learning strategies in collaboration with favela actors. The research design is proposed by a team of educators, headed by me as the first author of this paper. I have been an Instructional Designer at the Secretariat of Science, Technology, and Innovation of the State of Rio de Janeiro for over ten years, and a science educator with at least 17 years of experience in the classroom. The inspiration for this project comes from my trajectory of activism in social movements and my interest in activism through data. The dream of another world possible through education, solidarity, affection, and cooperative relationships that go beyond market logic led me to choose to work in territories, as well as the unfavorable context in which the population of the global South finds itself in the face of the data deluge and the absence of DL programs designed by and for the Brazilian population. I invite the public and other researchers to join this proposal due to its intrinsically collaborative nature.

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