Designing Socio-Technical Digital Health Interventions for and with Low-resource Communities

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ABSTRACT

Appropriate infant and young child feeding (IYCF) practices are crucial to promote a healthy and diverse diet in early life and prevent malnutrition. In low-resource settings, contextual (cultural, socioeconomic, and political) factors can hinder childhood development and increase the risk of malnutrition and other non-communicable diseases in the future. Information and Communication Technologies (ICTs) offer opportunities to tackle these challenges; however, designing and deploying technologies remains a major challenge especially in low-resource settings. Taking a Participatory Design approach, this research investigates how to use and adapt co-design methods to foster the engagement and participation of low-resource communities in the design process of socio-technical health interventions to support complementary feeding practices.

CCS CONCEPTS

• **Human-centered computing → Human computer interaction (HCI)**.

KEYWORDS

Co-design, Participatory Design, Complementary Feeding, Low-resource Communities, Healthcare Settings

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1 SCOPE OF RESEARCH

1.1 Research motivation

Childhood malnutrition is a major global health issue. In 2020, the World Health Organization estimated that 45% of deaths of children under five years old are related to preventable nutritional factors [38]. Especially during the complementary feeding period (6-24 months), the Infant and Young Child Feeding (IYCF) practices play a crucial role in achieving optimal early childhood development [6]. However, IYCF practices around the world are increasingly showing a high consumption of unhealthy food and may predispose children to be more likely to have poor eating habits [28] and potentially develop non-communicable diseases [21] later in life. In low-resource settings, this can be aggravated by dietary decisions that families make influenced by context, cultural, socioeconomic, and political factors that can hinder childhood development and increase the risk of malnutrition (anaemia, obesity and overweight) [11, 22, 26]. Information and Communication Technologies (ICTs) offer opportunities to tackle these challenges through supporting monitoring children's growth [19], becoming aware of snacking behaviour [32], as well as promoting caregiver's healthier eating decisions for their children [10]. However, designing and deploying these technologies in low-resource settings remains a major challenge. Participatory Design (PD) approaches seek to engage people in designing their future technologies, promoting mutual learning between participants and empowering them to have the possibility to influence the design process and/or outcomes of products and/or services [1, 15]. Nevertheless, the level of engagement and role of participants (including the facilitator) [13], situated power dynamics [8], and socio-cultural factors [16] make it challenging to apply PD in low-resource settings. Hence, creating or re-adapting PD methods and tools is necessary to support the engagement with low-resource communities and help community participants share their ideas, experiences and knowledge to co-design digital health technologies in their own context [35].

2 RESEARCH AIM

This research seeks to explore how to use and adapt co-design methods to foster engagement with low-resource communities to enhance their participation in the design process of socio-technical health interventions. In this project, we have focused on a case study related to supporting complementary feeding practices in Peru. We have involved caregivers (e.g., mothers and other family members) and healthcare professionals (HCPs) of children under two years old, leveraging their experiences and knowledge regarding children of this age. We explored what design tools or materials could enhance the participation of low-resource communities, allowing us to further understand the challenges and facilitators during co-design sessions.

2.1 Research questions

The research questions associated with this research project are:

- How can we adapt or create design tools and materials to support the participation of the low-resource communities during the co-design process of socio-technical health interventions?

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- What are the socio-cultural factors that facilitate or hinder the process of co-design with low-resource communities?

3 BACKGROUND

For design tools and materials to support different stages of the design process, such as brainstorming, ideation activities, prototyping, etc., this project has been inspired by Sanders and Stappers [31], Lucero et al. [20] and Roy and Warren [30]. In particular, Till et al. [35] and Coleman et al. [5] that have used visual materials such as challenge and design cards in South Africa to help community participants express their concerns and experiences in the context of maternal and child health.

The work of Bødker et al. [1] and Wagner [36] strongly influenced the PD approach of this work in designing technologies. However, in the low-resource setting context of this research, it is necessary to adapt the PD approach, as [35] and [5] did it. For the co-design workshops, the work from Hansen et al. [14] and Rosner et al. [27] have been part of the road map to define the type of workshops that we wanted to include during the research. In addition, we engage with caregivers and healthcare professionals (HCPs) as proxy-users [7, 12, 18, 34] since infants and toddlers usually depend on their caregivers for care. Furthermore, HCPs and caregivers have expertise in children's development and concerning children's eating habits. As guidance to conduct workshops with caregivers of children under two years, the work of Wardle et al. [37] has been crucial.

4 CASE STUDY: METHODOLOGICAL APPROACH

4.1 Research context

This project is part of a larger multidisciplinary research project that started in 2019 with the objective of tackling the double burden of malnutrition in children aged 6-23 months in peri-urban communities in Peru. In particular, Manchay (Lima) in the coastal region and in the city of Huánuco (Huánuco district) in the Andean highlands of the country.

4.1.1 Manchay, Pachacamac District. Manchay is a peripheral area between hills and arid regions with limited paved roads located in the Pachacamac district in the province and department of Lima in Peru. In the Pachacamac district, around 30.6% of children aged 6 to 35 months have anaemia [9]. This area is recognised as a low- and middle-low-income settlement where the income of the household is between S/863.72 - S/1,073.00 and less than S/863.71 per month ($1 = S/3.71) [4]. The healthcare centres provide childhood immunisation, nutritional counselling and growth monitoring, by a diverse group of healthcare professionals (HCPs), including nutritionists and nurses [25].

4.1.2 Huánuco, Huánuco District. Huánuco is a city located in the district and department of Huánuco in Peru. During 2022, the prevalence of anaemia among children of 6 to 35 months in Huánuco was a worrisome 51.8% [17]. Huánuco provides health services to the community with a more homogeneous group of healthcare professionals (HCPs), predominantly with nurses as healthcare providers/personnel [25].

4.2 Positionality

Aware that my background and experiences can influence how I shape the research and analyse data [3, 23, 33], I state my positionality. I am a Latin American woman born in Mexico; I speak Spanish and English. Currently, I am a PhD student in Cardiff, Wales, in the UK. My research project is situated in Peru, where I have worked with caregivers, health promoters and HCPs of children under two years. For this, I consider it important to say that I don't have children, but during my master's project, I worked with psychologists, teachers and children with autism, among others. Furthermore, I recognise that my previous experiences could have influenced not only the analysis but also the outcomes, such as prototypes and materials for the co-design process. During this process, I tried to be mindful of the power dynamics between me, as the researcher, and the participants, working as a facilitator rather than a designer or a developer. In addition, I have been supported by a research team from Peru, the UK and France, experts in public health, nutrition and human-computer interaction (HCI) with many years of experience working with low-resource communities to follow the best practices for conducting research in the Global South.

4.3 Participatory Design Methods

The research methodology for this project is divided into three phases in two cities in Peru: (1) Pre-Design Work, (2) Co-design workshops and (3) Evaluation of co-produced prototypes [29]. For the Pre-Design Work phase, we conducted semi-structured interviews to understand the current IYCF practices in households and the participants' experiences and challenges. In addition, we used a day-in-life visualization of caregivers' routines and storyboards as prompts to discuss challenges from previous research. Furthermore, I designed Context Cards depicting Peruvian stakeholders and existing local resources and strategies to support complementary feeding as well as technology cards, to be used in the following co-design workshops. For the second phase, we conducted four types of co-design workshops: ideation workshops, future workshops [24], storyboard workshops, and prototype workshops [25]. For the third phase, I conducted formative and summative evaluations of the resulting co-produced prototypes, engaging HCPs and caregivers to gather their perspectives and recommendations. I collected the data through observation, interviews and surveys.

4.4 Progress to date

At this point, I have completed the data collection of the three planned phases of this research. The analysis for the different phases of this work is currently in progress. Specifically, the first phase includes a Thematic Analysis [2] of household interviews together with the visual outcomes from the day-in-life routine visualisations. The second phase includes the analysis of the different co-design workshops to identify the challenges and facilitators in participation for HCPs and caregivers of children under two years old, as well as the co-created outcomes. The third phase includes the analysis of the formative and summative evaluation of the co-created prototypes (tangible mat and mobile app) for caregivers and children under two years old.

4.5 Intended contributions

With my work, I aim to contribute empirically and methodologically to the field of HCI as well as with two co-produced prototypes: an interactive mat for children under 2 years old and a mobile application for caregivers of children under two.

4.5.1 Empirical contributions. First, the empirical contribution of the research includes the data collected from interviews during the field study to further understand the challenges and opportunities to develop healthy IYCF practices for children under two years. Second, as a result of the co-design process and the analysis of the participants' feedback, we will propose design considerations when creating contextual design materials for low-resource communities. Third, from the formative and summative evaluations of prototypes to identify and propose implications for design for tangible user interfaces and mobile health technologies for supporting healthy nutrition for children and enhancing the experience in the waiting area of healthcare centres.

4.5.2 Methodological Contribution. One of my methodological contributions is a set of Context Cards validated for researchers, HCPs and caregivers, and used during the ideation and storyboard workshops, supporting the design process with Peruvian communities. Another is the use of rapid sketching to create the visual materials (visualization of design ideas and design concepts) for the co-design workshops to support the shared understanding, participation and reflection throughout the co-design process. In addition, based on our methodological reflections and lessons learned we got while conducting the co-design workshops, we plan to share the findings regarding the roles, socio-cultural and spatial challenges and facilitators for participation with heterogeneous groups of participants such as HCPs, health promoters and caregivers in low-resource settings in Peru.

4.5.3 Artifact Contributions. The co-design and development of:

(1) an interactive mat to support the familiarisation of children and caregivers with healthy food for the waiting area of low-resource healthcare centres.
(2) a mobile application to support parents managing the health and wellbeing of their infants as well as the nutritional practices.

4.6 Plans for further research

Based on the presented work, future work could explore more deeply the perspectives and perceptions of caregivers and healthcare professionals involved during the co-design process. Furthermore, the set of Context Cards could be used in different contexts to see their use, adoption or adaptation. In addition, further research could be done to conduct a cross-case analysis with other projects in the Global South to see similarities and differences.

4.7 Limitations

An important limitation of this work is that although it is intended to affect children under two years, they mostly depend on their caregivers for assistance. Thus, caregivers and HCPs play a key role during the design process as experts of children under two years old. Additionally, our presence and conduction of the co-design workshops could have influenced the engagement of participants. Finally, it is a case study that can not be generalised but contributes to understanding how we can design socio-technical digital health interventions for and with low-resource communities.

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