International Journal of Child-Computer Interaction 39 (2024) 100621

Contents lists available at ScienceDirect

International Journal of Child-Computer Interaction

journal homepage: www.elsevier.com/locate/ijcci

Towards culturally sustaining design: Centering community's voices for learning through Participatory Design

Maria J. Anderson-Coto [a,*], Julie Salazar [a], John Louis-Strakes Lopez [a], R. Mishael Sedas [a], Fabio Campos [b], Andres S. Bustamante [a], June Ahn [a]

[a] University of California, Irvine, Irvine, CA, USA
[b] New York University, New York, USA

ARTICLE INFO

Keywords:
Participatory Design
Culturally Sustaining Pedagogies
Playful learning
Culturally sustaining design

ABSTRACT

Embedding cultural ways of knowing and being of non-dominant communities into learning tools and environments often falls short of authentically representing the people they are meant to serve. Designers have used principles and methods of Participatory Design (PD) to work alongside minoritized communities due to its roots in democratic participation. However, following PD methods may fall short when infusing the community's culture and values in the design in a way that is responsive to the community's preferences, intentions and aspirations. In the field of education, researchers and practitioners have designed teaching and learning tools and environments by leveraging the cultural wealth and ways of knowing of minoritized learners through an asset-based perspective, as exemplified by Culturally Sustaining Pedagogy (CSP). In this paper we present a case study for the development of a mobile application to extend physical playful learning spaces, designed with local low-income Latine families to foster fun family learning. We highlight how our design practices helped us center youth voices and community ways of knowing and being, particularly in the stages of ideation, concept, testing, and prototyping. Our case study reflects how we foregrounded cultural values and practices into our educational mobile application. Through these practices, we present concrete examples and initial building blocks for future work towards building a Culturally Sustaining Design Framework.

1. Introduction

Designers of educational technologies are increasingly interested in Participatory Design (PD), an approach that aims to integrate the interests and values of community members when designing interventions or products (DiSalvo, Clement, & Pipek, 2013; DiSalvo, Yip, Bonsignore, & DiSalvo, 2017; Simonsen & Robertson, 2013). Despite this democratic and inclusive objective, the implementation of PD methods may fall short of representing and infusing the design with the community's identities, culture and preferences in a way that they want to be represented (Bødker & Kyng, 2018; Harrington, Erete, & Piper, 2019; O'Leary, Zewde, Mankoff, & Rosner, 2019; Rosner, Kawas, Li, Tilly, & Sung, 2016). Culture is oftentimes embedded in design in ways that do not represent minoritized populations, and PD workshops may overshadow local knowledge and participants' preferences by prioritizing the desired outcomes and expectations of the designers (Rosner et al., 2016). The intended democratic values of PD do not imply a meaningful application and translation to cultural experiences by proxy. For example, community members may not be comfortable sharing deep parts of themselves without a trustworthy relationship established prior, especially if they have a historical relationship of exploitation and extraction with researchers and universities (Harrington et al., 2019). In other cases, initiatives such as PD sessions unintentionally overshadow the participants' understanding of what design means in favor of the researchers' expectations or desired outcomes (Irani, 2018; Rosner et al., 2016; Yosso, 2005). Although existing case studies highlight these areas of tension during PD, it is less clear in the literature how designers and researchers can authentically integrate cultural knowledge from partners into playful and educational environments.

To explore this issue, we build from culturally relevant pedagogy (CRP) (Ladson-Billings, 1995, 2014) and its evolution to culturally sustaining pedagogy (CSP). CRP was developed to subvert deficit practices of teaching and learning, and critically place learners and the knowledge they bring to the center of practice. Paris (2012) offers CSP as an evolution of CRP, aiming towards cultural pluralism and fluidity

* Corresponding author.
E-mail address: mjander2@uci.edu (M.J. Anderson-Coto).

https://doi.org/10.1016/j.ijcci.2023.100621
Received 1 March 2023; Received in revised form 10 October 2023; Accepted 31 October 2023
Available online 10 November 2023

while challenging the role of traditional education by considering the intersectional identities and fluid cultures of minoritized students as models for instruction, not simply receivers of instruction.

Our project also builds on a PD approach to design a mobile, web-based application that accompanies a Playful Learning Landscapes (PLL) initiative. PLL are physical installations that encourage meaningful play and learning experiences for children and their families in everyday spaces (e.g., bus stops, parks and grocery stores). Our goal is to create an app that integrates our community partners' knowledge and culture into the everyday activities that families can do to learn science, technology, engineering and math (STEM) concepts in a playful and meaningful way. The mobile application that we are developing aims to support families as they locate PLL sites in the city, while continuing the fun experiences from the PLL sites at home or on-the-go. To understand community cultural values and knowledge, we held six co-design sessions with over 40 families and community organization directors. Throughout these sessions, we sought to integrate culturally sustaining practices in our PD process, to result in a prototype that brings to light and embeds indirectly stated cultural values and practices of our partners. The following questions guided our understanding to develop a culturally sustaining PD approach:

1. How do we identify our participants' values, contexts, and ways of knowing and being in the process of designing technology?
2. How do we support designers in reflexively translating the community's values, contexts, and ways of knowing and being into culturally sustaining design assets?

We begin by exploring literature related to Human-Centered Design and PD, and highlight a need for integrating concepts from a CSP approach into PD practices. Next, we outline our PD process that led to the current design for our mobile application. The mobile game guides families through their city, helps them find PLL installations, and facilitates educational games that extend from the installations. Through our case study, we illustrate how we foregrounded cultural practices and values into aspects of game design, such as characters, storyline and game mechanics. In particular, we focus on how we noticed participant contributions and were attuned to nuanced sociohistorical and economic contexts. We illuminate how attending to community perspectives can help to infuse designs with elements that sustain a communities' values, practices, and culture.

Our paper contributes to the field in two ways. Firstly, human–computer interaction (HCI) methodologies and design theories, such as PD, have taught the field about different strategies to directly include minoritized community partners in the design process. Our contribution integrates CSP tenets to highlight communities' ways of knowing and being throughout the design process and within elements of the design product. Secondly, while CSP identifies cultural aspects that have to be attended to in learning environments, the literature does not address how to incorporate these aspects into design processes. We provide case examples and design vignettes that highlight how to integrate a CSP perspective with PD methods, when undertaking the critical process of translating a local community's core values into concrete design ideas.

2. Background

2.1. Human-Centered Design

Human-Centered Design (HCD) is a design approach that centers people and their needs, motivations, emotions, and behaviors in the development of an artifact or system (Steen, 2011). Instead of focusing on the design to be "user friendly", particularly by the end of the design process, HCD involves stakeholders and their values early in the process to promote "user-friendliness" throughout the design process (Garcia-Lopez, Mor, & Tesconi, 2020). The design approach to create a new product or system does not follow a straightforward linear process from an idea to the final product. A design process requires multiple iterations back and forth within ill-defined design phases. The process generally starts with a framing phase where designers reflect on the users' desire to change something, such as solving a problem (Paton & Dorst, 2011). Then, in the reframing phase, designers re-interpret the design task and context to find alternative and innovative ways of seeing and representing the problem space. Designers aim to generate actionable steps and shared views of a desired outcome, including an agreed scope and context-specific constraints (Paton & Dorst, 2011). The final phases include the ideation of possible creative solutions, followed by iterative evaluations and testing of prototypes to determine if the designed outcomes fulfill user needs and meet the design scope under particular constraints.

2.2. Participatory Design

While our design approach follows the HCD philosophy of centering people and their needs throughout the design process, we also draw from similar traditions in Participatory Design (PD), a design approach that involves the people who will use the final solution as a critical partner throughout the design process (Bødker, Dindler, Iversen, & Smith, 2022; Schuler & Namioka, 1993; Simonsen & Robertson, 2013). PD originates from the Scandinavian worker movements in the 1970s where people wanted to participate in the decision-making that affected their workplaces and lives (Simonsen & Robertson, 2013). Nowadays, the variety of settings where researchers use PD has increased, especially when working with minoritized communities, given its attractive history of empowerment (Cho, Herrera, Chaidez, & Uriostegui, 2019; Harrington et al., 2019; Racadio, Rose, & Kolko, 2014; Vacca, 2017). For example, Vacca (Vacca, 2017)used PD as a way to study Latine adolescent–caregiver relationships and understand teen's perspectives on how technology plays a role in mediating their relationships with their caregivers. Another example is Cho and colleagues (Cho et al., 2019), who used PD and asset-based design approaches to design a messaging system for Latine mothers to find informal learning activities for their children. PD has also found its way to the interdisciplinary field of learning sciences to consider how designed environments and technologies influence play and learning (Gomez, Kyza, & Mancevice, 2018). For example, learning scientists have utilized PD to develop informal STEM programs and social media tools that build from the assets of low-income communities (Ahn, Clegg, Yip, Bonsignore, Pauw, Gubbels, Lewittes, & Rhodes, 2016; Clegg et al., 2012; Yip et al., 2016, 2017). Thus, PD is an approach that may advance, develop, implement and sustain learning innovations (DiSalvo et al., 2017).

Recent scholarship highlights how despite involving partners in the design process, PD researchers could still impose normative perspectives in the design process, silence the voices of minoritized or marginalized groups, or be carried by the positive aspects of the method while insulating themselves from the negative effects of the methodology and design (Bardzell, 2018; Harrington et al., 2019; O'Leary et al., 2019; Racadio et al., 2014; Rosner et al., 2016). Within academic and practice communities focused on PD, considerable attention has been dedicated to investigating the dynamics surrounding the agendas brought forth by various participants and the ultimate authority vested in individuals responsible for translating identified needs into tangible design features (Meyer, Waterman, Coleman, & Strambler, 2023; O'Leary et al., 2019; Vakil, Royston, Nasir, & Kirshner, 2016). Similarly, Dollinger, Liu, Arthars, and Lodge (2019) revealed how several learning design studies fall short of capturing the essence of co-creation, which extends beyond the mere co-production of an artifact, to instead also encompass the generation of values and fostering of relationships. While we build from PD as a foundational element of our design research, our team has also been grappling with questions for how to better integrate the perspectives and cultural ways of knowing and being that our community partners bring to our design projects.

2.3. Culturally Sustaining Pedagogy

Culturally Sustaining Pedagogy (CSP) is a pedagogical framework that focuses attention on how to understand learning environments through the lens of intersectional justice and desettling practices (Paris, 2012, 2021). The aim is to subvert deficit practices of teaching and learning by critically placing learners as the main resource of knowledge and skills (Freire, 1970b; Ladson-Billings, 2014; Paris, 2021). Through criticality, self-reflexivity, a strong commitment to social justice, and using asset-based discourses, CSP fosters, sustains and perpetuate students' linguistic, literate and cultural pluralism on both traditional and current practices while offering access to dominant cultural norms and practices (Paris, 2012). Thus, applying CSP implies a radical epistemological shift: knowledge needs to emerge from learners' and educators' lived experiences and ways of knowing instead of being passively given to them (Freire, 1970a; Ladson-Billings, 2014; Paris, 2012).

According to Paris (2021), CSP is characterized by: (1) critical centering of the dynamic nature of culture, language and practices across the learning setting, (2) intergenerational community agency and participation in the learning environment, (3) maintaining a good relationship with the land, students, and communities, (4) providing opportunities to critically reflect through inward gaze, analyzing damaging biases present in our communities that get internalized. CSP practitioners could also falter by oversimplifying and assigning a deterministic nature to cultural practices or perpetuating ways of being external and contradictory to their own communities and values (Paris & Alim, 2014). For example, while using Hip Hop battles in the classroom may seemingly serve students of color, especially young men, some scholars rarely mention how this practice may unintentionally reproduce forms of gender exclusion (Paris & Alim, 2014). Most importantly, CSP principles need to motivate educators to engage with youth with a critical view to not only value their strengths and assets, but also encourage an inward gaze to expose ways where minoritized youth could perpetuate oppressive beliefs and behaviors.

2.4. Moving from culturally relevant to culturally sustaining design

The specific term culturally relevant design surged in the last decade as a way to include intricacies of culture to increase the effectiveness of persuasive designs with case studies in areas such as web development (Sachau & Hutchinson, 2012) and health and wellness (García-Batista et al., 2020; Orji & Mandryk, 2014; Oyibo, Orji, & Vassileva, 2018). Culturally relevant design involves Hofstede's cultural dimensions to highlight characteristics that normative technology may be missing. For example, adding features of social support for a collectivist oriented culture (Orji & Mandryk, 2014; Oyibo et al., 2018), or involving user's frequented spaces in the designs, such as recognizable landmarks (García-Batista et al., 2020). While this approach may be useful to understand common cultural dimensions, it may fall short when incorporating the fluid and nuanced cultural practices of the community in a way that is truly meaningful and useful for the community. For example, Hofstede categorized communities based on individual traits, such as individualism and power distance (Shaiq, 2011). These categories may be useful to understand general inclinations, however, these broad categorizations lose sight of the nuanced and different values, histories, cultural knowledges and ways of being inside the same population (Shaiq, 2011).

While explicit merging of the culturally relevant framework in combination with PD have been increasingly applied in many educational settings to create curricula and learning environments (Belgrave et al., 2022; Coppola, Woodard, & Vaughan, 2019; Novak & Khan, 2022; Vetter et al., 2022), there is little research done on applying CSP in a design environment to sustain communities' ways of knowing and being through design. In the same way that education theorists and practitioners have moved from culturally relevant to CSP, we argue that design research and practices has the opportunity to adopt culturally sustaining approaches. We raise the following question: How can we bring CSP values into a design space to help transform design into something that sustains communities?

In traditional design processes (e.g. the commonly "professionalized process of contextual inquiry, sketching and brainstorming, and iterative prototyping and feedback" O'Leary et al., 2019), user's identities, cultures, and complex structural effects of race and ethnicity are commonly seen as discrete variables (Harrington et al., 2019; O'Leary et al., 2019). This approach can position design as potentially disconnected from the communities who use them, and even unintentionally replicate systemic issues (Irani, 2018; O'Leary et al., 2019). An increasing number of technology designs rely on designer-defined requirements, personal perspectives on culture, and their own interpretation of the target audience (Oyibo et al., 2018). However, this approach may not capture the community's own realities, preferences, values, and cultural practices that are oftentimes implicit and pass unsee by designers. For example, these methods may assume there is a neutral or unproblematic relationship between the community and the researcher (Dillahunt et al., 2017). The community might question the relevance of the researcher's approach to their daily lives and realities (Harrington et al., 2019). Concentrating on designer-specific perspectives may also shift the researchers' attention from different ways of technological innovation that are already happening inside the communities (Wyche et al., 2012). Furthermore, using design thinking as a form of expertise may be problematic, since it puts value on technology-oriented ideas valued by researchers, while decentralizing existing resources and assets in the community (Irani, 2018). Thus, designers and research partners need more guidance such as models and frameworks that incorporate ways of knowing and being to enhance the design process (Young, 2008).

Drawing from CSP's four key features (Paris, 2021), the democratic participation of PD, and centering community cultural wealth in the design process (Yosso, 2005), we offer insight into designing technology to uplift and sustain communities' cultural forms of knowledge, skills, and abilities. We aim to understand how to identify, understand and explicate participants' values, contexts, and ways of knowing and being in the process of designing technology, and then how do we support designers in reflexively translating the community's values, contexts, and ways of knowing and being into culturally sustaining design assets.

3. Methodology

3.1. Design setting and context

We situate our project within the broader work of PLL (Belgrave et al., 2022; Hassinger-Das, Bustamante, Hirsh-Pasek, & Golinkoff, 2018). PLL seeks to design learning opportunities for communities that lack access to high quality, informal learning environments such as museums and science centers (Belgrave et al., 2022). Each initiative applies the Playful Learning framework (Pesch et al., 2022), facilitating family dialogue and STEM learning through interactive, meaningful play. Our project team has engaged in a three year co-design process with a local community of low-income, Latine families to create PLL in grocery stores, bus stops and parks in their own city. For example, we co-designed grocery store signage that taught mathematics concepts like measurement conversion, in order to provide STEM learning opportunities throughout the store (Belgrave et al., 2022). In 2021, our partnership received a grant to design a mobile game application that would enhance our families' learning experiences with PLL and extend their on-site activities to digital experiences.

Our PD process to develop the mobile application involved six co-design sessions with over 40 families and community organization directors. These PD sessions occurred between October 2021 and June 2022. Although our work with our community partners will continue, this paper covers the timeline described up to the initial writing of this paper. In this paper, we focus our analysis on three PD sessions,

Table 1
Overview of PD sessions.

Date and goals	Activities
(1) October 18, 2021. Goal: Introduce past design work and technological enhancements and answer the following question: "How can technology help learning together as a family?"	Activities: (a) Presentation led by facilitators to provide an overview of what has been done and present goals for the current project. (b) Storytelling describing the last time families used technology. (c) Storytelling about the type of technology families imagine being incorporated at the different installation locations. (d) Community share out (i.e., families as codesigners share with all the session attendees).
(2) October 25, 2021. Goal: Create new technology. Post the question: "How can people use the new technology in public spaces?"	Activities: (a) Prime participants with themes that arose from the last design session. (b) Storytelling about tying themes with installation locations. (c) Storyboarding activity to communicate how we can design new technologies for the city that promote family learning. (d) Community share out.
(3) November 1, 2021. Goal:Create a technology prototype that is relevant, meaningful and interesting to families.	Activities: (a) Discuss prompts and brainstorm what is relevant, meaningful, and interesting. (b) Create prototypes of imagined technology using provided crafting materials. (c) Community share out.
(4) December 13, 2021. Goal: Gather ideas and perceptions about two prototypes: The Abacus and Frida Mural	Activities: (a) A story is presented followed by questions. (b) Go through 'story prompts' with our participants, asking them for fine details of interactions. (c) Community share out.
(5) June 27, 2022 and (6) June 30, 2022 Goal: Create stories and characters for the hidden world of Bizumia	Activities: (a) Present storyline of the mobile application. (b) Caregiver groups: Storytelling, sharing stories from their childhood. (c) Children groups: Create characters. (d) Community share out.

consisting of design sessions numbers 2, 5, and 6 found in Table 1. These specific sessions best model different stages of the design process and showcase how we used CSP principles to generate our design approach. In design session 2, we (researchers and community partners) imagined technology for an existing physical installation that later informed subsequent design sessions and early stage prototypes. During sessions 5 and 6, participants engaged in storytelling. Storytelling was chosen as a method alongside the PD since it helps bring forth the historical and cultural context, importance and purposes of the family and community experiences across multiple forms of expressions and temporalities (Barajas-López & Bang, 2018). In these sessions, parents were asked to tell us stories from their own childhood, while youth drew and designed characters with background stories, dilemmas, and powerful abilities, which they presented to the group. In "Storytelling as Research", Wilkins (2000) defends that stories are "the ordinary language of ordinary people" (p.144), a mode of expression that allows for rich, hidden features of a group to emerge and be revealed. In that sense, creative acts such as contributing to a collective story or drawing a made up character become ways for accessing "expressions of experience" (p.146) and a possible key to unveiling underlying cultural meanings.

Ideas and characteristics from youths' designs and parents' stories were used to develop characters that we called Bizus, or Bizu in the singular. This name was created as a placeholder by a Brazilian member of our research team and comes from Portuguese slang for inside tip or advice, as these characters are meant to guide players through a fun, hidden world overlaid upon their existing city. In line with the name, the hidden world beneath the city was named Bizumia. When we presented the characters to our community design partners, we explained the story behind the name, but said that we wanted them to propose other possible names for the characters and world. However, the name and motivation resonated with our design partners and they chose to keep it because they liked the meaning and that it is short, catchy, and easy to pronounce in Spanish. In this paper, we will refer to the characters that are developed for the app as Bizu (s), and the world as Bizumia. Throughout our analysis, we highlight the process through which our partnership developed detailed insights about the cultural experiences and practices that our community partners sought to foreground in the resulting technology design.

3.2. Participants

We identified and invited our design partners through an existing relationship with Santa Ana Early Learning Initiative (SAELI), a non-profit organization in the Southwestern United States. SAELI consists of families, teachers and school administrators from a local school district, focused on providing resources to low-income families to promote positive development. Our relationship with SAELI continues after 5 years of participating in previous projects (Belgrave et al., 2022; Pesch et al., 2022).

Participants in our co-design sessions were family groups or pairs, commonly one caregiver and one or several children. We define a caregiver as a member of the household taking care of the child. While in our sessions, all caregivers were also parents of the child, we choose to use the term caregiver to be inclusive of other adults who care for children as Latine families often have extensive family networks. A total of 32 caregivers (n = 1 father, n = 31 mothers) and 66 children attended the sessions including two program directors. The majority of our participants spoke predominantly Spanish (n = 31) (Bermudez et al., 2023). Many of the families had engaged in co-design sessions for the development of grocery store signs, bus-stops, and playgrounds through the PLL initiative (Belgrave et al., 2022). As such, many of the families were interested in supporting the technological enhancements of these installations.

The research team consists of undergraduate students, graduate students, and two professors who collaborated on this project, from participatory design sessions to developing prototypes of the app. As a team, we offer our participants a bilingual space, since caregivers and children have varying degrees of English and Spanish fluency. Our adult design partners preferred to speak Spanish during sessions and children preferred English. Thus, Spanish speaking members of our team led the caregiver groups and English speaking members led the child groups. The majority of our research team speaks Spanish and identifies as Latine and other members of our team identify as Asian. In this particular study, five of the authors speak Spanish, with the first and fourth authors' native language being Spanish. Although this facilitates the communication and rapport-building with the participants, the relationship with this community partner extends back years and a lead member of our team does not speak Spanish.

We highlight this point because cultural and language match is not a requirement for authentic and meaningful partnership work. Even though the majority of our research team identify as Latine, that term is broad and members of our team (or their families) come from a variety of countries including Cuba, Costa Rica, Puerto Rico, Brazil, and Mexico. Each of these countries have their own distinct cultural values and practices, as well as tremendous linguistic variability within each country. Following Vakil et al. (2016), we are also conscious that our identities did not grant us automatic entry, acceptance, nor trust with our community partner. Rather, it was a multi-year investment in relationship building and a collaborative alignment of effort towards mutual goals (Tseng, Easton, & Supplee, 2017).

3.3. Data sources

All data came from audio and video recordings of the three participatory design sessions, numbers 2, 5, and 6, held between October 2021 and June 2022 (Table 1). We provided dinner and compensated each family for their participation in each session. In the first session (session 1), we asked participants their preferred language, and prepared our materials according to their preferences. From there on, each co-design session started with our Spanish-speaking facilitators introducing the design activities which also had instructions in English, which were focused on several design aspects, such as storytelling, character development, and concept testing. During breakout groups, we separated caregivers and children into groups by age. For instance, in session five, we had groups of children ages 7–8, 9–10, 11–12, and 15–16, and two parent groups.

We offered participants a variety of writing and crafting materials so they could express, design and iterate ideas in response to prompts. Each activity encouraged community members' imaginations represented in a variety of ways, from storyboards, comic strips, sticky notes, "bags of stuff" (Druin, 1999), drawings, or prototypes. We photographed images and scans of all design artifacts produced. In sessions five and six, caregivers engaged in telling stories they heard from their elders or families, while children told stories about the characters they created. Research assistants also produced memos and observational notes. At the end of each session, facilitators and research assistants met and reflected upon the sessions by sharing and writing reflective memos, which were then added to our data corpus.

3.4. Data analysis

We began the analysis through developing an initial round of codes to describe our observations, transcripts, and other participant generated artifacts. Instead of starting from an external framework or theory through a deductive approach, we chose to follow an inductive approach to coding and thematic analysis throughout our process (Saldaña, 2016). This was a crucial decision for our process since the codes emerged from the participants' own words and voices. Throughout our process, we followed a cycle of facilitating design sessions, analyzing the data, and then using the insights to inform future sessions. For example, our first design session with families focused on the prompt *How might our family use technology?* Emerging themes such as *communication*, *games*, and *information* informed questions in our second co-design session, where we asked families to specifically design technology for PLL. Another key focus of our design process was to ensure that features of our design were not merely a direct translation or adoption of community members' ideas. Instead, we sought to identify implicit cultural values within each idea and allow these values to guide refined elements of our application design and generate new areas for engagement in other co-design sessions.

Following our session 3, our research team met to member-check and synthesize the generated ideas into several themes for possible mobile game options. We went through several cycles of iteration of each idea, where the design team presented several proposals to the broader research team for feedback. Between sessions 4 and 5, our team synthesized ideas generated from prior sessions into a game concept centered around Bizus. Sessions 4–6 occurred in the midst of this iterative refinement to include families' feedback and increase alignment with the interests and expectations of the community.

As the community agreed on Bizus as the desired concept, we integrated audio and artifact data with inductive thematic analysis (Saldaña, 2016) of a Bizu-creation activity by the community, to more clearly identify community core values and rationales behind each Bizu created. While developing the new rounds of themes, we met on a weekly basis to compare our impressions of emerging themes and establish agreement on the coding. These codes became the key ideas that informed further elements of the design, character stories, personalities, and in-game activities.

4. Findings

This section presents emergent findings from our design sessions. The bold words indicate themes that emerged during the data analysis, which we will intertwine through narrative with selected excerpts of our participant's storytelling. The first and second section will focus on the parent's storytelling, the third section focuses on the children's characters, and the fourth section focuses on our approach to centering the themes from the previous sections as the base for the design work.

4.1. Socio-historical and economic contexts and practices during ideation processes

In co-design session 2, we presented the themes that reflected families' underlying goals for a mobile game: learning new topics, staying active through hands-on experiences, creative expression, and engaging in activities with their family. Using these themes, participants imagined technology to use at these PLL sites and the types of interactions around them. Participants shared stories of how these sites could be infused with design themes followed by a storyboarding activity where they designed technologies to promote an environment of fun family oriented learning.

A group of caregivers developed a measurement machine at the supermarket where children could weigh a fruit or vegetable and see the conversion between Metric (kilos) and Imperial (pounds) systems (Fig. 1). A weighing feature would tell them the change in price from the weight, teaching children the relationship between weight and cost. Instead of stopping there, we asked the families to explain why they chose the feature(s) and what inspired their ideas. Through this conversation, caregivers shared stories of migration from Mexico where they follow the Metric system. However, when they came to the United States, they adapted to the Imperial system, often resulting in inconvenient, yet humorous experiences for when these conversions went wrong (e.g., ordering too much ham at the deli). Through these stories, families created a design for promoting rich math learning opportunities, that was rooted in their own family histories and meaningful cultural experiences related to migration.

Caregivers also wanted to create opportunities where children would learn about fruits and vegetables. They designed a scanner where anyone could scan a fruit or vegetable and learn about the nutritional value of the item, the country where it was grown, health benefits, and recipes for the item. Knowing that food came from other places and following its journey to their current home in the United States closely resonated with the caregivers' migratory experiences. Caregivers also saw this activity as an opportunity to transmit their culture and history to provide a connection to their home countries for their children. Caregivers expressed sentiments of pride and joy when sharing knowledge of food tied to the regions they grew up in.

Children were futuristic with their ideas, often involving robots in their designs, and expecting technology to have high levels of autonomy. Several designs created opportunities to learn about spatial

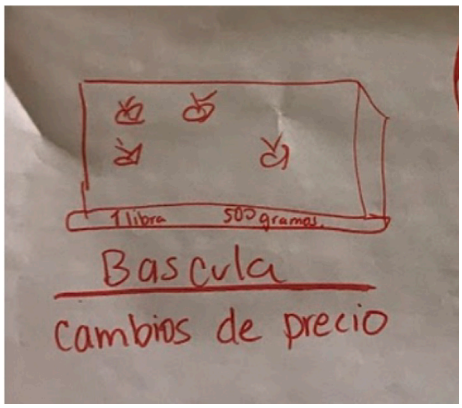


Fig. 1. Drawing of the weighing machine.

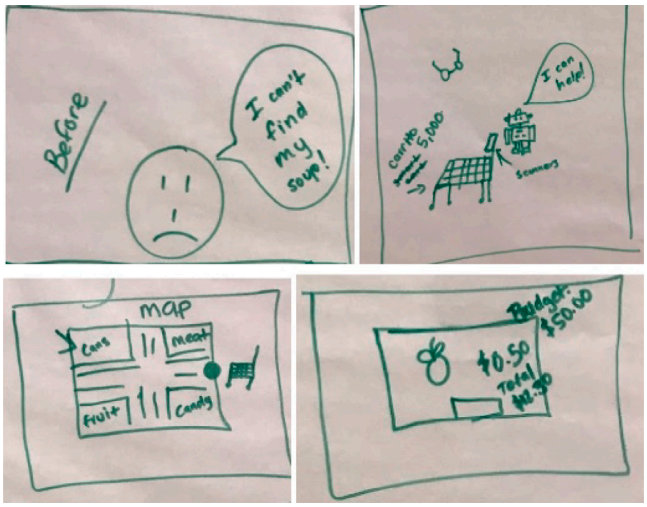


Fig. 2. Storyboard about Carrito 5000.

awareness and map use. For example, they designed *Carrito 5000*, a smart shopping cart that would help them navigate the grocery store by showing a map of the store and where an object is located (Fig. 2). By following the map, they could make their visits to the store quicker and more efficient. Other cart features included a scanner that would scan items and tally the price as they shop and give a subtotal, which engaged children in math and financial literacy. While these ideas sound futuristic and unattainable in design, the principles that motivated them revealed participants' culture and lived experiences. For example, by having conversations with the family units, we discovered that children were keenly aware of the everyday experiences of their families and socio-economic contexts and designed technology that met the priorities of their families. In caregiver conversations around the grocery store, navigating the store quickly and efficiently and keeping a strict budget were paramount to the grocery shopping experience. This design demonstrates a consistent theme of how children imagined complex technology to meet practical everyday challenges they face with their family.

4.2. Attuning to intergenerational ways of knowing and being through storytelling

The following themes emerged from sessions 5 and 6 where caregivers were asked to share stories or legends that were shared in their community or they were told as a child. These stories helped us understand the nuanced family histories and give even more context to the ways of being present in the community. Through these stories, families connected through similar lines of beliefs, values and practices, even when they were from different towns or even countries within Latin America. We also noticed that these themes were present in children's character creations (Section 4.3), so we had a better understanding of where these themes came from.

Caregivers' stories commonly started by giving a context grounded in land and people. Two caregivers, one from Mexico and another from Honduras, opened their stories in a similar way as shown in Table 2.

While both stories are very different in context and characters, both caregivers start by stating who told them the story, usually someone who they consider part of their family, and describing the town it is set in, which usually coincides with the town they are from, and other relevant historical events in that location. This rich context helps the listener understand the meaning and relationship between the storyteller, the land, and people from the story. Rooting places in their personal and historical meaning creates a personal connection where people have cared about land for generations, and become invested in caring for it. The story shared by the caregiver from Honduras included a treasure that was hidden in a farm that belonged to her grandparents, where her family had lived for several generations. However, when caregivers talked about an event or story taking place in the city they currently live in, they did not show that same personal-historical connection nor talk in as much detail about the context beyond street names and daily occurrences such as driving by the place. This stark contrast was expressed by a caregiver: "*They're stories that don't happen in this country [United States]. They're experiences that happen back in our towns, but it's different here. Maybe it's because of different cultures". (Translated from Spanish)*. These emergent themes around the value of grounding stories in a meaningful personal family history related to the land set a direction for our design process. We aimed to infuse our overarching approach with the care and personal relevance that caregivers transmit in their stories to sustain these cultural values in the current city where their children are growing up.

The caregivers also described a thin barrier between personal accounts, stories and legends, similar to the literary tradition of magical realism.[1] Peoples' interactions with supernatural occurrences and events in their community are real and part of their daily life. Magical creatures are intelligent, powerful beings that can affect humans through different ways such as bodily effects, visions, fear, and dreams. Interactions with magical beings like ghosts, *duendes* (gnome-like creatures), or having strange feelings are not uncommon. The existence of magical beings or experiences are not questioned by people in the story nor by the listeners, as expressed in the quote in Table 3. This acceptance of magical realism, in conjunction with migration, inspired the concept of Bizumia as a fantasy world that exists alongside the world we live in, and through the mobile application, we could travel between both worlds. Moreover, Bizumia came to represent the invisible layers of culture and experience of migrants that often get obscured by the daily life in a foreign land.

Through their stories, caregivers also indicated that it is up to the human involved to figure out the meaning of the interaction and the intention of the magical being, which may be unpredictable and even fatal. Thus, while some stories portray a passive participation from family members, such as telling someone about the event, or "feeling" something, a lot of stories portray active involvement of family members and elders in deciphering and solving different situations. In Table 4, we see how the family members helped each other solve the issue at hand. The storyteller's brother started to play with the *duendes* being oblivious of the dire consequences of his actions. Their grandfather helped solve the issue through his knowledge and instructed

[1] "Latin-American narrative strategy that is characterized by the matter-of-fact inclusion of fantastic or mythical elements into seemingly realistic fiction" (Britannica, 2023).

Table 2
Home and land descriptions.

Caregiver's story (Spanish)	Translation (English)
"Yo les quiero compartir porque es lo más reciente - a escasas unas semanas atrás que mi papá me lo platicó y yo siempre lo supe. Yo soy de Puebla, el pueblito se llama Huehuetlán El Chico. Ahícuando fue la batalla de Puebla [el 5 de Mayo], ese pueblo fue invadido por la batalla. Ahífue como quien dice lo mero bueno de la situación, era Puebla."	*"I want to share with you my most recent [story] - a few weeks ago my dad talked to me [about it] and I always knew. I'm from Puebla, from a small town called Huehuetlán El Chico. When the [5 of May] battle of Puebla happened, the town was invaded by the battle [since] Puebla was the "core" of the situation."*
"Tengo una tía que dice que tiene muchas visiones y cuenta que en mi aldea- Soy de Honduras y mi aldea se llama Las Minas. Le dicen las Minas porque antes habían minas de oro ahíen mi aldea."	*"I have an aunt who says she has a lot of visions and she told me that in my village - I'm from Honduras and my village is called The Mines. It's called The Mines because there were gold mines [a while ago?] in my village."*

Table 3
Regarding magical creatures.

Caregiver's story (Spanish)	Translation (English)
"Creas o no creas, las cosas existen (...) yo por ejemplo, yo soy católica pero no quiere decir que no crea en los aluxes porque si existen. Pero eso no dice que perdiste el sentido de tu creencia en Dios. Si existen, igual que los duendes."	*"Believe [in them] or not, things do exist. (...) For example, I am Catholic but that doesn't mean that I don't believe in aluxes because they do exist. That doesn't say that you lost your belief in God. [The aluxes] do exist, same as duendes."*

the mom to make an offering at the spot where the brother interacted with the *duendes* so the brother would not die. The active involvement of family members from a historical and socio-cultural perspective strengthened our team's position on involving the families in not only the activity themselves, but also inside the narratives presented through the app and the games.

In our design sessions, human-creature interactions often took the form of warning signs that the human should correct their behavior or actions, which highlight how stories are told to also relay information about *educación* or expectations of behavior and ethics from the community. While values may be shared in many cultures, caregivers commonly referenced Latin American legends in their stories, which offered insight into broader cultural contexts that may be inspiring the stories. In Table 5, the person not only highlights how their elders warned them against greed as the primary motivation for seeking gold, but also the consequences of one's actions. However, not all the stories are about warnings. Some stories highlighted community values such as helping others in their time of need. The story in Table 6 highlights the positive values of maintaining hope, empathy, compassion, and extending a helping hand to those who are in their time of need, even when they are magical or "otherworldly" beings.

4.3. Children's character development: The origin of the Bizus

From the first four design sessions, our team synthesized ideas that generated a game concept centered around Bizus to help users navigate an alternative world while interacting with playful learning spaces. In co-design sessions 5 and 6, when children were introduced to Bizus, our intent was having children create these characters, their background stories, traits, and other aspects. While they used a worksheet as a guide, they were free to use multiple mediums provided in the session.

Children communicated deep desires and experiences through the characters they designed, including their need to have social connections, community values, relationships with their peers, and a sense of inclusion. These characteristics mirrored parent's expressions of relationships with others and expectations of educación, such as close family ties, involving intergenerational family members in problem-solving, being courteous, and helping others in time of need Section 4.2.

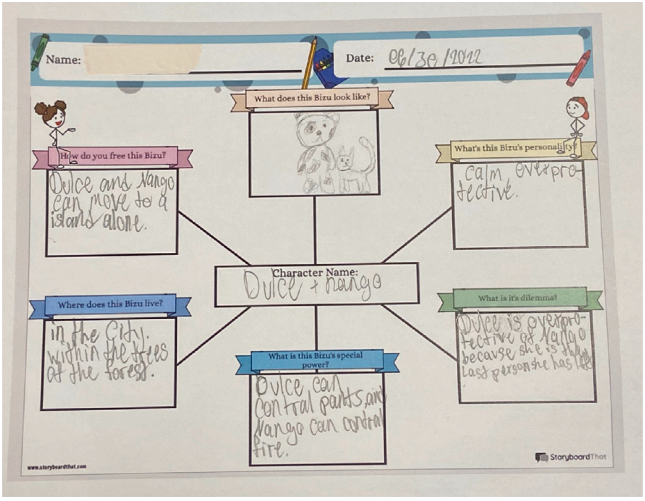


Fig. 3. Children's worksheet portraying Dulce and Mango's story.

While parents expressed these characteristics explicitly, children conveyed them through narratives and characters.

For example, a child created a sibling-like duo, "Dulce and Mango", where one sibling feels protective over the other due to their close relationship (Fig. 3). The child wrote that *"[Mango] is the last person [Dulce] has left"*. Together, they lived in the city, and described how they could move to an island together to feel safer. These characters demonstrated the strong ties within families and the importance of family relationships that resonated with the child co-design partner. Additionally, the need for safety and protection through moving is a meaningful value for immigrant families.

Descriptions of characters' personalities often resonated with the values of being ***bien educado***, by respecting and helping others. For example, one child created the Bizu Ayu, short name from the Spanish word *ayuda*, which means help. Ayu was created to *"help lost people by giving directions"* giving this character the ability of understanding spatial awareness and providing directions to others (Fig. 4). This Bizu directly mapped to the parents' stories and values of being compassionate and helping others without any expectations of something in return.

Lastly, character development included social-emotional aspects such as managing emotions and validation from others. One child partner designed a flower-caretaker Bizu named Zizie, whose ears were shaped like big hearts, which made her different from the rest (Fig. 5). When hurtful comments about her ears made her sad, her magical powers caused flowers to wilt around her. The child's task in the game environment is to support and encourage Zizie by learning empathy and body-positive affirmations such as *"it doesn't matter what other people*

Table 4
An encounter with *Duendes*.

Caregiver's story (Spanish)	Translation (English)
"*[Cuando] mi hermano y yo éramos pequeños, dice mi hermano que le hablaban los "monitos", eran los duendes. Y mi hermano de repente le decía a mi mamá "¡Ya no quiero ir! Es que unos niños me hablan" y [mi mamá] no se lo llevó verdad y se le empezaron a hacer las orejitas así paradas. Entonces mi abuelo le dice [a mi mamá] "sabes que? tienes que llevarles flores, y ahí donde él los miró porque si él juega con ellos él puede morir". Mi mamá fue con un cigarro y les puso flores y todo eso. Y a mi hermano se le pararon las orejas - ya no les fueron creciendo*"	"*[When] my brother and I were small, my brother said that the "dolls" would talk to him. They were duendes. My brother suddenly was telling my mom 'I don't want to go there anymore! The children talk to me!' and [my mom] didn't take him away and his ears started to grow pointy. My grandfather then told [my mom] 'you know what? you have to take flowers to the place he saw them [the duendes], because if he plays with them he may die'. My mom went with a cigar and flowers and all [to the place]. Then, my brother's ears stopped growing.*"

Table 5
A warning sign.

Caregiver's story (Spanish)	Translation (English)
"*Como decían mis abuelitos, cuando tu tienes un mal pensamiento de decir 'oh, cuando tenga el oro lo voy a gastar en mujeres o en bebida. No mas se oye el ruido, y si más se entierra el tesoro'. Ya no puedes agarrarlo luego. Oyes el ruido cuando se va enterrando solito cuando tu tienes pensamientos no buenos de donde vas a invertir ese dinero.(...) Ya estaban en la [última] capita de lo que era la caja. Donde mi tío tuvo ese pensamiento [negativo], dice mi papá, 'nosotros sentimos que temblaba! El baúl se sacudió y se hundió más'.*"	"*"Like my grandparents said, when you have a bad thought and say 'oh when I have the gold I'll spend it all on alcohol and women', you will hear a sound as the treasure buries itself [deeper]. You hear that sound when you have bad thoughts about how you will invest the money (...) They were about to [remove] the last layer of dirt where the box was. When my uncle had that [negative] thought, my dad said 'We felt the earth shaking! The treasure chest shook and sank more.*"

Table 6
Community values.

Caregiver's story (Spanish)	Translation (English)
"*Una vez [el chofer] venía de [la Ciudad de] México a Guadalajara (...) Dice que cuando él venía manejando sintió que le tocaron la espalda entonces dice que le habló una persona pero dice [que] estaba muy nervioso, se heló. Entonces dice que pues vio por el espejo y vio una sombra que traía atrás, pero que dice que le habló y que le dijo que él ya estaba muerto que había tenido un accidente automovilístico y quería descansar y que sólo le pedía que le hiciera una misa para él poder descansar (...) Con el transcurso del tiempo volvió y llegó al pueblo que le dijo el difunto y si le fue a hacer su misa. (...) Pasó el tiempo y volvió a subir para el norte y dice que se le subió el difuntito otra vez para agradecerle y que ya a ahora podía descansar en paz y que estaba muy agradecido con él y que desde hoy lo iba a cuidar. Esa es la historia que me contó.*"	"*One time, a driver was going from Mexico [City] to Guadalajara (...) He told me that when he was driving, he felt a tap on his back and someone talked to him. The driver got really nervous and felt cold chills. He peeked through his [rearview] mirror and there was a shadow behind him and [the shadow] talked to him and said he (the shadow) had died in a car accident and he wanted the driver to do a mass in his name so he could move on (...) Some time after, the driver eventually went to the town that the deceased told him about, and paid the priest for the mass (...) Time passed and the driver was driving north again, and the dead person appeared again to thank him and tell him he could move on, he was very thankful and he would look after the driver from now on. That's the story he [the driver] told me.*"

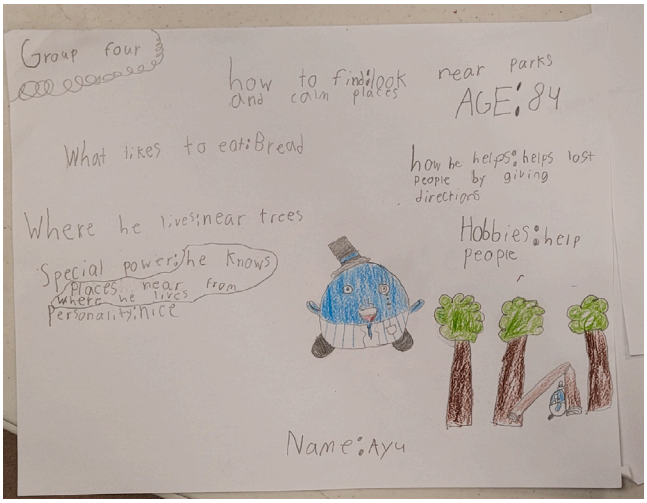


Fig. 4. Child's drawing and explanation of Ayu.

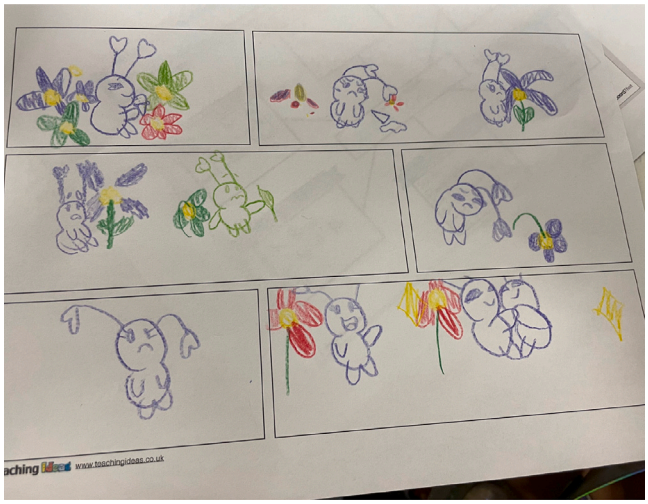


Fig. 5. Storyboard about Zizie.

think about [you]". Through this Bizu, we restore a strong relationship with nature as well as the strong community bonds of caring commonly shown in Latine families, teaching the child that their emotions matter. However, being there for others through empathy and showing those values is equally important. Hence, the children enter this interaction through the role of a supportive friend, who not only helps Zizie feel better, but also helps them care for the land through nourishing flowers.

4.4. Translating cultural values and practices into design prototypes

By incorporating the emergent themes from caregiver groups (Section 4.2) and children's Bizu creations (Section 4.3) into the game's design and narrative, we were able to translate some of the meaningful values and practices into the design of the mobile phone application.

Bizus embody the spirit of magical realism transmitted by the caregivers and elders' stories. Following those stories and the desires of autonomy from children, Bizus are intelligent, independent creatures

Fig. 6. First draft of Babo.

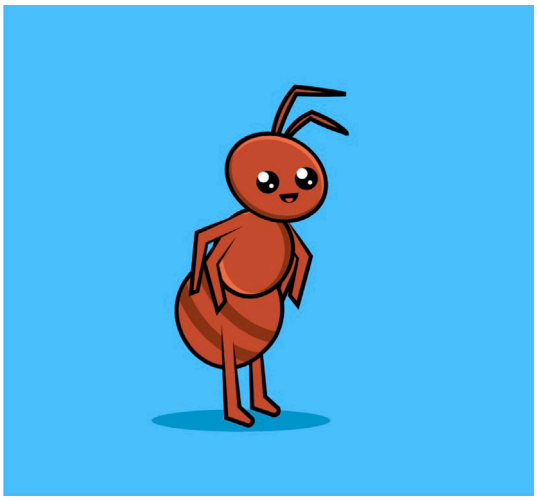


Fig. 7. Baby Kien from the Kien family.

with special powers that can affect their surroundings and have active relationships with humans, other Bizus, and Bizumia, the world of Bizus. As we designed the game world of this mobile application, we framed Bizumia as a completely different world parallel to their own city to elicit the sense of migration and navigating-between-worlds that families expressed. In the game, Bizus will ask the child and their families for help through a fun activity and teach them something in return, eliciting community values that came up in both child and caregiver stories, such as helping others, compassion, and empathy. By helping and learning from Bizus, children unlock the next Bizu story and interaction. Bizus also have relationships with one another, creating a close community where Bizus care about each other and take care of Bizumia together. Figs. 6 and 7 illustrate our first drafts of Bizus for the app prototype.

In the resulting mobile application, children will start in their home city where they meet Babo (See Fig. 6), who emerged from the idea of one of our child co-designers. Many children expressed being shy, yet they wanted to socialize and be included. These experiences were reflected in Babo, the tiny, inquisitive, timid guardian of Bizumia. In our game world, Babo accidentally falls into a portal that connects Bizumia and our human world, and needs the player's help to get back to his home. The first interaction between the Bizus and the player happens by helping Babo in a navigation-related activity to find the portal. As a way to thank the player, Babo invites them to Bizumia. Then, children will help other Bizus and their families, and take care of the land they live in. Through the physical installations across the city that will be complemented by this app, we intend to connect children to their own land and help them understand how these activities relate to promoting positive values and healthy relationships with their communities.

Another Bizu inspired by the values of hard work and family-centered thinking is the ant-like Kien family Fig. 7. The Kien family goes to the grocery store to buy food with a plan, knowing already what they want to get and how much they can carry. However, they find it hard to choose products due to the big size of their family. The player will help determine how much each Kien family member can carry by converting units of mass between metric (kg) and imperial (lb) systems. The Kien family portrays a scenario where children are engaged in helping other family members through resource management and numeric conversion. In this case, instead of budgeting money, as the design ideas directly suggested, we budget weights that each family member could carry. As the level progresses, the player aids each member of the Kien Family, while the story unfolds, depicting the family's shopping activities and their journey back home.

5. Discussion

The examples above demonstrate the cultural practices and knowledge that emerged from PD sessions. Through understanding the socio-economic and historical contexts, and values present in our sessions, we offer a rich example of culturally sustaining design.

5.1. Understanding our partners' ways of knowing and being

The first research question was to explain our process of identifying participants' values, contexts, and ways of knowing and being in the process of designing technology. In other words, how do we understand and discover beyond underlying practices and priorities? HCD's philosophy of centering people, needs, values, and behaviors, and PD's democratic core of participation give us a great start into listening to our participants and centering their voices and making an artifact that is relevant to their lives. However, how can we go beyond relevancy to the cultural experiences and practices of communities to "support young people in *sustaining* the cultural and linguistic competence of their communities while simultaneously offering access to dominant cultural competence".(Paris, 2012). In our process, this was possible through three factors that stem from CSP: building a relationship beyond trust with our design partners, attuning to the specific intersectional contexts of our participants and their values and priorities, and understanding the fluidity of cultural practices.

The relationship between us and our community partners did not emerge only for this project, nor is seen as a transactional, one-way relationship that benefits only researchers. Our team spent years forming a relationship with our partners. Similar to Vakil and colleagues' work (Vakil et al., 2016), we engage in a sociopolitical conscious relationship by building trust beyond good intentions having transparent discussions about each party's priorities, goals, and possible outcomes of the partnership. Through questioning our own positions of power, what we are making visible, and whose voices we were representing, we defined and communicated our role as facilitators and as tools for the community. We aim to achieve their goals and priorities and sustain their cultural practices and languages while offering access to STEM knowledge through fun, meaningful learning engagements that are desirable for them. Beyond this project, our team also engages in a service capacity with this organization supporting several initiatives and contributing expertise like grant writing and communication/advocacy with local city government on organizational initiatives. Thus, common design practices already used in PD, such as adjusting to our participants' availability and work schedule, providing

food and compensation for their time, conducting all of our sessions in Spanish, and engaging in service and advocacy for the community were part of building and maintaining a key feature of CSP, "right relations to provide the right environments for co-design work" (Paris, 2021). Without building a solid foundation of mutual trust and solidarity, and fostering a sense of common purpose and belonging (Ehret & Hollett, 2016) such as the ones Vakil et al. (Vakil et al., 2016) indicates, getting to know and uncover the implicit meanings of values and ways of knowing would have been difficult.

Second, we followed another key feature of CSP by centering the specific socio political, economic, historical, and cultural contexts and practices of our participants (Paris, 2012, 2021). In PD, we provided multiple activities and forms of expression such as drawing and storytelling that enable us to access multiple forms of knowledge and ways of expression that are valuable to the community (Barajas-López & Bang, 2018; Yosso, 2005). We also responded to feedback to present materials and methods of engagement that were relevant to the community and were not infantilizing or belittling (Harrington et al., 2019). We were able to capture seemingly unrelated parts of our participants' lives and ways of knowing and being that gave us insight into values and priorities, their meaning and connections within the community. Our design activities elicited participants' community-oriented goals, how resilience, empathy, and helping others played a role in getting to those goals, a strong connection with magical beings and the history of their community, and social expectations of good behavior. We also opened the opportunity for facing internalized oppression and false choices (Paris, 2012, 2021). In the case of the caregivers, we noticed their stories often recognized the backgrounds they came from and hardships they had to endure while expressing hope for their children avoid repeating decisions or attitudes that did not help their growth. In the case of children, their drawings expressed their understanding and questioning of topics such as the relationship between immigration, loneliness, and isolation from the rest of the family (e.g. Dulce and Mango), or navigating social situations such as bullying. In their drawings and stories, children showed how they drew from their family's values, love, and support in order to navigate these situations and counter negativity through actions such as making affirmations that empowered them instead of seeking external validation (e.g. Zizi).

Third, we attempted to understand not only the language, heritage, and cultural roots that caregivers expressed (e.g. customs and traditions), but also their contemporary cultural practices, interests and priorities. Making space for the enactment for not only past (i.e. traditional, heritage) cultural practices, but also modern interpretations and evolving practices is key for culturally sustaining practices (Paris, 2012, 2021). For example, part of the caregivers' perception of community meant keeping a balance between family/community cohesion, adapting to the new environments, and maintaining traditions alive. This was in turn attuned to their personal stories of migration, uncertainty, and their wish for their children to have a better future. In the children's case, through their drawings, we noticed that the sense of community mirrored their caregivers' backgrounds by prioritizing the creation of safe environments for their loved ones while helping others in playful ways. However, attuning to our participants' contexts, understanding the intersectional fluidity of cultural practices, and incorporating the reflection of our position is not just a matter of seeing the previously "unseen" and applying it in a design. Rather, similar to what Bang & Vossoughi (Bang & Vossoughi, 2016) indicate, it challenges us on how to make different design decisions and think about our role in design based on the new perceptions and understandings of our participants.

5.2. Infusing our design with culturally sustaining principles

Our second research question expands the first by addressing how to support designers in reflexively translating the community's values, contexts, and ways of knowing and being into culturally sustaining assets. In our case, adopting a culturally sustaining approach meant applying our findings and considering how we infuse our PD process with our new understandings of the cultural practices, ways of knowing and being reflected in our Findings and Section 5.1. First we infused artifacts and stories into the game narrative, elements, characters and activities while maintaining their values and cultural knowledge. Second, having PD's democratic iterative processes as the base, we were able to implement another CSP feature by empowering the community and incentivizing intergenerational participation by elevating their expertise and agency as design partners.

In the app design, we took into consideration caregivers' experiences with their immigrant histories such as dealing with conversion units, their preferred language, Spanish, and children's lived experiences in the U.S speaking predominantly English. In order to sustain their language and promote intergenerational participation, we decided to make the app fully bilingual and allow participants to change between Spanish and English seamlessly. In a similar way, we showed both pounds and kilograms whenever mass is displayed. The constant switching between languages is a cultural expression for children, who commonly switch between languages, which is deeply tied to their unique identities — each language symbolizing a part of their lives. Thus, the negotiation between languages and units are merged as a cultural practice, and represented as a normal part of the gaming experience (Fina, 2007). This seemingly easy switch helped us go beyond superficial design decisions such as naming characters in Spanish, to intentionally designing experiences that highlight intergenerational interactions within families by having caregivers and children exercise their language assets to promote mutual development (e.g., caregivers learning English and children learning Spanish).

Another example is the preservation of the caregivers' connection and care with the land they came from, associating it with their own families, histories, and traditions. We noticed that while caregivers expressed care and relationships with their home countries, they reported not feeling the same in their current city. Thus, we aimed to inspire feelings of care and connection with the land by recreating the sensations of discovery and care that families expressed about their home countries. We designed activities and characters that were related to a specific place and had reciprocal relationships with their environment. The goal was to transmit and sustain the cultural values of care and connection to the land so children might develop these feelings of care for their own city.

A third example of infusing culturally sustaining principles into our design decisions through out mini-game design and overall narrative is through the development of an activity that included budgeting and resource management. This is a delicate and nuanced topic when someone has lived in situations with limited resources. Families' stories played a pivotal role in determining the location of the games and activities, such as the supermarket, and inspired the characters' background stories and goals. Our community partners are predominantly low-income families who immigrated to the United States and through their stories, we learned that they had similar financial goals, and know-how that were rooted in their personal histories, problem solving skills, and ingenuity. For example, the Kiens, the ant family in our prototype, highlight the importance of budgeting, community values such as helping each other, and having common goals as a family. In this game, the Kien family go shopping at the grocery store, and have the goal of buying a certain amount of produce. However, each family member can carry a limited amount of weight and children (players) have to help them optimize their load so they can get the food they need from the grocery store as a team. In this example, we use weighing as a metaphor for resource management to uphold a community asset and practice while respecting families' concerns about focusing children's attention on financial resources or a lack thereof. The weight metaphor allowed us to infuse the game with community knowledge, assets, and values without oversimplifying the context or invoking feelings of discomfort in what is meant to be a joyful family activity.

Our second point addresses the iterative nature of design while including communities not only in a moment at the beginning and at the end of the design, but continuously throughout the process. Following lines of work such as Bang et al. (2014), our process is an iterative dialogue through multiple co-design sessions, where we respect and elevate community expertise and agency as design partners through different forms of active participation. Furthermore, when holding the co-design sessions with the community, we did not just go to the community for traditional validation or testing of our designs. We started from their ideas and values around technology, learning, cultural practices and the contexts of their stories and lived experiences. We aimed to uncover implicit cultural values through a mix of coding rounds, reflections, and conversations with participants and each other. Then, we added our own expertise through design and academic literature to center these ideas within design concepts, and connect them with the PLL goals. Thus, during our testing, we went beyond usability, asking the community if design ideas fit with what they had imagined, with their worldview, priorities, values, and identities, and if they see this as something they would use in the future.

In a traditional design context, caregivers may be positioned as co-users or facilitators of our digital app, while the end user would be the child. However, aligning with CSP (Paris, 2012, 2021), scholars such as Bang et al. (2014), and our community's practices of involving family members and elders (Section 4.2), we promoted intergenerational participation in both the design and usage of the application. While children and caregivers were in-situ and engaged as participants and users, we included the voices of elders through the caregivers' storytelling as active participants throughout the design process. Caregivers' and elders' stories helped us understand common beliefs, community structures, perceptions around historical events, places of origin, and community values. Children's drawings and character designs provided a starting point for character creation, their personalities, and important framings of how they see their families and evolving cultural practices. We then translated key insights and values into the characters and interactions that our application will spark to sustain and build from communities cultural wealth and history.

6. Conclusion and future work

Involving minoritized communities in design environments in a way that represents and sustains them in a way that they want and prefer is not an easy task. In this paper, we present a case study that highlights how we incorporated CSP perspectives inside a PD design process through the stages of ideation, testing, and prototyping. We build from, and add onto, these techniques with ways to attend authentically to the values and cultural practices of our design partners. Through building an intentional long-term relationship beyond trust with our design partners, attuning to the specific intersectional contexts of our participants and their values and priorities, making room for self-reflection and critique, and understanding the fluidity of cultural practices we were able to better understand our design partner's ways of knowing and being. After understanding the explicit and implicit ways of knowing, being and practices of our design partners, through the participatory iterative process alongside the community, we facilitated intergenerational participation, creation, and feedback, which guided and attuned our design interactions.

While our work has centered around the initial data collection and design aspect of the interface, the iterative process with the community does not end there. Our next steps involve going back to the community with a mid-level prototype containing the Bizus described and soliciting feedback on the characters, stories, and activities for iterative improvement. This next step will inform the final version of the app and ensure that we capture the values and visions of our community partners. Upon further iterations, refinement and launching of the app, we will examine how our community partners perceive and learn from the activities. While this study does not describe how culturally sustaining design manifests in final design products, we find value in describing the early design process and how it is forming the foundations for culturally sustaining designs. Future work should consider how to embed and analyze culturally sustaining design practices in other applications deployed in communities at later stages of the design process. We hope our first steps will inspire other designers and researchers to take a CSP approach in their design process and work alongside a community to create learning environments and tools that reflect the priorities and cultural values of their co-design partners.

7. Selection and participation of children

This research is compliant with the ethics standards from an Institutional Review Board. We identified and invited our design partners through an existing relationship with SAELI, a non-profit organization in the Southwestern United States consisting of families, teachers and school administrators from a local school district, focused on providing resources to low-income families to promote early childhood STEM education. Our relationship with SAELI continues after 5 years of participating in previous projects (Belgrave et al., 2022; Pesch et al., 2022). For this work, we collaborated with approximately 32 caregivers, 66 children, and two program directors throughout the co-design sessions. Many of our families had engaged in previous co-design sessions for the development of grocery store signs through the PLL initiative (Belgrave et al., 2022).

All guardians gave informed consent for their child's participation and data collection. In each co-design session, the facilitators orally explained the consent form study procedure to the children and parents at the beginning of each session, and answered any questions. During the participatory sessions, the children and parents were reminded that they could discontinue the study or stop participating at any time. Each codesign session required the child's guardians to be present and participate for the whole duration of each session.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

Acknowledgments

We want to thank our partners, directors, and families, for putting their trust on us, and opening the doors in their community. We also want to thank SAELI for their support. We would like to thank our research assistants, Isabella T. Seccia, Selina Arjomand, Caroline Guzylak, and Min Joo Kim, for the valuable contributions to the design. This work is supported by the Heising-Simons Foundation, United States and National Science Foundation, United States (#2005776). Any opinions, findings, and conclusions expressed in this material are those of the author(s) and do not necessarily reflect the view of the National Science Foundation or the Heising-Simons Foundation.

References

Ahn, J., Clegg, T., Yip, J., Bonsignore, E., Pauw, D., Gubbels, M., et al. (2016). Seeing the unseen learner: designing and using social media to recognize children's science dispositions in action. *Learning, Media and Technology*, *41*(2), 252–282. http://dx.doi.org/10.1080/17439884.2014.964254.

Bang, M., Curley, L., Kessel, A., Marin, A., Suzukovich, E. S., & Strack, G. (2014). Muskrat theories, tobacco in the streets, and living Chicago as Indigenous land. *Environmental Education Research*, *20*(1), 37–55. http://dx.doi.org/10.1080/13504622.2013.865113.

Bang, M., & Vossoughi, S. (2016). Participatory design research and educational justice: Studying learning and relations within social change making. *Cognition and Instruction*, *34*(3), 173–193. http://dx.doi.org/10.1080/07370008.2016.1181879.

Barajas-López, F., & Bang, M. (2018). Indigenous making and sharing: Claywork in an indigenous STEAM program. *Equity & Excellence in Education*, *51*(1), 7–20. http://dx.doi.org/10.1080/10665684.2018.1437847.

Bardzell, S. (2018). Utopias of participation: Feminism, design, and the futures. *ACM Transactions on Computer-Human Interaction*, *25*(1), 6:1–6:24. http://dx.doi.org/10.1145/3127359.

Belgrave, A. B., Bermudez, V. N., Chew, P., Lin, Y., Ahn, J., & Bustamante, A. S. (2022). Using a participatory design approach for co-creating culturally situated STEM enrichment activities. *Journal of Applied Developmental Psychology*, *82*, Article 101451. http://dx.doi.org/10.1016/j.appdev.2022.101451.

Bermudez, V., Salazar, J., Garcia, L., Ochoa, K., Pesch, A., Roldan, W., et al. (2023). Designing culturally situated playful environments for early STEM learning with a Latine community. *Early Childhood Research Quarterly*, http://dx.doi.org/10.1016/j.ecresq.2023.06.003.

Bødker, S., Dindler, C., Iversen, O. S., & Smith, R. C. (2022). *Synthesis lectures on human-centered informatics*, *Participatory design* (1st ed.). Springer Cham.

Bødker, S., & Kyng, M. (2018). Participatory design that matters—Facing the big issues. *ACM Transactions on Computer-Human Interaction*, *25*(1), 1–31. http://dx.doi.org/10.1145/3152421.

Britannica Magic realism, Britannica, 2023 URL https://www.britannica.com/art/magic-realism.

Cho, A., Herrera, R. G., Chaidez, L., & Uriostegui, A. (2019). The "Comadre" project: An asset-based design approach to connecting low-income Latinx families to out-of-school learning opportunities. In *Proceedings of the 2019 ACM conference on human factors in computing systems* (pp. 1–14). Glasgow, Scotland Uk: Association for Computing Machinery, http://dx.doi.org/10.1145/3290605.3300837.

Clegg, T., Bonsignore, E., Yip, J., Gelderblom, H., Kuhn, A., Valenstein, T., et al. (2012). Technology for promoting scientific practice and personal meaning in life-relevant learning. In *Proceedings of the 11th international conference on interaction design and children* (pp. 152–161). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/2307096.2307114.

Coppola, R., Woodard, R., & Vaughan, A. (2019). And the students shall lead us: Putting culturally sustaining pedagogy in conversation with universal design for learning in a middle-school spoken word poetry unit. *Literacy Research: Theory, Method, and Practice*, *68*(1), 226–249. http://dx.doi.org/10.1177/2381336919870219.

Dillahunt, T. R., Erete, S., Galusca, R., Israni, A., Nacu, D., & Sengers, P. (2017). Reflections on design methods for underserved communities. In *Companion of the 2017 ACM conference on computer supported cooperative work and social computing* (pp. 409–413). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/3022198.3022664.

DiSalvo, C., Clement, A., & Pipek, V. (2013). Communities: Participatory design for, with and by communities. In *Routledge international handbook of participatory design* (1st ed.). Routledge.

DiSalvo, B., Yip, J., Bonsignore, E., & DiSalvo, C. (Eds.), (2017). *Participatory design for learning: Perspectives from practice and research*. Routledge.

Dollinger, M., Liu, D., Arthars, N., & Lodge, J. (2019). Working together in learning analytics towards the co-creation of value. *Journal of Learning Analytics*, *6*(2), 10–26. http://dx.doi.org/10.18608/jla.2019.62.2.

Druin, A. (1999). Cooperative inquiry: developing new technologies for children with children. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 592–599). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/302979.303166.

Ehret, C., & Hollett, T. (2016). Affective dimensions of participatory design research in informal learning environments: Placemaking, belonging, and correspondence. *Cognition and Instruction*, *34*(3), 250–258. http://dx.doi.org/10.1080/07370008.2016.1169815.

Fina, A. D. (2007). Code-switching and the construction of ethnic identity in a community of practice. *Language in Society*, *36*(3), 371–392. http://dx.doi.org/10.1017/S0047404507070182.

Freire, P. (1970a). *Pedagogy of the oppressed*. New York: The Continuum International Publishing Group Inc.

Freire, P. (1970b). Cultural action for freedom. *Harvard Educational Review*.

García-Batista, Z. E., Guerra-Peña, K., Alsina-Jurnet, I., Cano-Vindel, A., Herrera Martínez, S. X., Jiménez-Payano, D., et al. (2020). Design of virtual environments for the treatment of agoraphobia: Inclusion of culturally relevant elements for the population of the Dominican Republic. *Computers in Human Behavior*, *102*, 97–102. http://dx.doi.org/10.1016/j.chb.2019.08.015.

Garcia-Lopez, C., Mor, E., & Tesconi, S. (2020). Human-centered design as an approach to create open educational resources. *Sustainability*, *12*(18), http://dx.doi.org/10.3390/su12187397.

Gomez, K., Kyza, E. A., & Mancevice, N. (2018). Participatory design and the learning sciences. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *International handbook of the learning sciences* (1st ed.). Routledge.

Harrington, C., Erete, S., & Piper, A. (2019). Deconstructing community-based collaborative design: Towards more equitable participatory design engagements. In *Proceedings of the ACM human-computer interaction, vol. 3*. New York: Association for Computing Machinery.

Hassinger-Das, B., Bustamante, A. S., Hirsh-Pasek, K., & Golinkoff, R. M. (2018). Learning landscapes: Playing the way to learning and engagement in public spaces. *Education Sciences*, *8*(2), 74. http://dx.doi.org/10.3390/educsci8020074.

Irani, L. (2018). "Design thinking": Defending silicon valley at the apex of global labor hierarchies. *Catalyst: Feminism, Theory, Technoscience*, *4*(1), 1–19. http://dx.doi.org/10.28968/cftt.v4i1.29638.

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *Americal Educational Research Journal*, *32*(3), 27.

Ladson-Billings, G. (2014). Culturally relevant pedagogy 2.0: a.k.a. the remix. *Harvard Educational Review*, *84*(1), 74–84. http://dx.doi.org/10.17763/haer.84.1.p2rj131485484751.

Meyer, J. L., Waterman, C., Coleman, G. A., & Strambler, M. J. (2023). Whose agenda is it? Navigating the politics of setting the research agenda in education research-practice partnerships. *Educational Policy*, *37*(1), 122–146. http://dx.doi.org/10.1177/08959048221131567.

Novak, E., & Khan, J. I. (2022). A research-practice partnership approach for co-designing a culturally responsive computer science curriculum for upper elementary students. *TechTrends*, *66*(3), 527–538. http://dx.doi.org/10.1007/s11528-022-00730-z.

O'Leary, J. T., Zewde, S., Mankoff, J., & Rosner, D. K. (2019). Who gets to future? Race, representation, and design methods in Africatown. In *Proceedings of the 2019 ACM conference on human factors in computing systems* (pp. 1–13). New York, NY, USA: Association for Computing Machinery.

Orji, R., & Mandryk, R. L. (2014). Developing culturally relevant design guidelines for encouraging healthy eating behavior. *International Journal of Human-Computer Studies*, *72*(2), 207–223. http://dx.doi.org/10.1016/j.ijhcs.2013.08.012.

Oyibo, K., Orji, R., & Vassileva, J. (2018). Developing culturally relevant design guidelines for encouraging physical activity: a social cognitive theory perspective. *Journal of Healthcare Informatics Research*, *2*(4), 319–352. http://dx.doi.org/10.1007/s41666-018-0026-9.

Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher*, *41*(3), 93–97. http://dx.doi.org/10.3102/0013189X12441244.

Paris, D. (2021). Culturally sustaining pedagogies and our futures. *The Educational Forum*, *85*(4), 364–376. http://dx.doi.org/10.1080/00131725.2021.1957634.

Paris, D., & Alim, H. S. (2014). What are we seeking to sustain through culturally sustaining pedagogy? A loving critique forward. *Harvard Educational Review*, *84*(1), 85–100. http://dx.doi.org/10.17763/haer.84.1.982l873k2ht16m77.

Paton, B., & Dorst, K. (2011). Briefing and reframing: A situated practice. *Design Studies*, *32*(6), 573–587. http://dx.doi.org/10.1016/j.destud.2011.07.002.

Pesch, A., Ochoa, K. D., Fletcher, K. K., Bermudez, V. N., Todaro, R. D., Salazar, J., et al. (2022). Reinventing the public square and early educational settings through culturally informed, community co-design: Playful learning landscapes. *Frontiers in Psychology*, *13*.

Racadio, R., Rose, E. J., & Kolko, B. E. (2014). Research at the margin: participatory design and community based participatory research. In *Proceedings of the 13th ACM participatory design conference* (pp. 49–52). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/2662155.2662188.

Rosner, D. K., Kawas, S., Li, W., Tilly, N., & Sung, Y.-C. (2016). Out of time, out of place: Reflections on design workshops as a research method. In *Proceedings of the 19th ACM conference on computer-supported cooperative work & social computing* (pp. 1131–1141). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/2818048.2820021.

Sachau, L. L., & Hutchinson, S. R. (2012). Trends in culturally relevant interface design features for Latino Web site users. *Educational Technology Research and Development*, *60*(6), 1033–1050. http://dx.doi.org/10.1007/s11423-012-9270-5.

Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). SAGE publications.

Schuler, D., & Namioka, A. (1993). *Participatory design: Principles and practices* (1st ed.). CRC Press.

Shaiq, H. M. A. (2011). Why not everybody loves Hofstede? What are the alternative approaches to study of culture? *European Journal of Business and Management*, *3*(6).

Simonsen, J., & Robertson, T. (Eds.), (2013). *Routledge international handbook of participatory design* (1st ed.). London: Routledge, http://dx.doi.org/10.4324/9780203108543.

Steen, M. (2011). Tensions in human-centred design. *CoDesign*, *7*(1), 45–60. http://dx.doi.org/10.1080/15710882.2011.563314.

Tseng, V., Easton, J. Q., & Supplee, L. H. (2017). Research-practice partnerships: Building two-way streets of engagement. *Social Policy Report*, *30*(4), 1–17. http://dx.doi.org/10.1002/j.2379-3988.2017.tb00089.x.

Vacca, R. (2017). Bicultural: Examining teenage Latinas' perspectives on technologies for emotional support. In *Proceedings of the 2017 conference on interaction design and children* (pp. 117–126). Stanford, California, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/3078072.3079742.

Vakil, S., Royston, M. M. d., Nasir, N. S., & Kirshner, B. (2016). Rethinking race and power in design-based research: Reflections from the field. *Cognition and Instruction*, *34*(3), 194–209. http://dx.doi.org/10.1080/07370008.2016.1169817.

Vetter, A., Faircloth, B. S., Hewitt, K. K., Gonzalez, L. M., He, Y., & Rock, M. L. (2022). Equity and social justice in research practice partnerships in the United States. *Review of Educational Research*, *92*(5), 829–866. http://dx.doi.org/10.3102/00346543211070048.

Wilkins, P. (2000). Storytelling as research. In B. Humphries (Ed.), *Research in social care and social welfare: Issues and debates for practice* (pp. 144–153). Jessica Kingsley Publishers.

Wyche, S. P., Oreglia, E., Ames, M. G., Hoadley, C., Johri, A., Sengers, P., et al. (2012). Learning from marginalized users: reciprocity in HCI4D. In *Proceedings of the ACM 2012 conference on computer supported cooperative work companion*. Association for Computing Machinery, http://dx.doi.org/10.1145/2141512.2141527.

Yip, J. C., Clegg, T., Ahn, J., Uchidiuno, J. O., Bonsignore, E., Beck, A., et al. (2016). The evolution of engagements and social bonds during child-parent co-design. In *Proceedings of the 2016 ACM conference on human factors in computing systems* (pp. 3607–3619). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/2858036.2858380.

Yip, J. C., Sobel, K., Pitt, C., Lee, K. J., Chen, S., Nasu, K., et al. (2017). Examining adult-child interactions in intergenerational participatory design. In *Proceedings of the 2017 ACM conference on human factors in computing systems* (pp. 5742–5754). New York, NY, USA: Association for Computing Machinery, http://dx.doi.org/10.1145/3025453.3025787.

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education*, *8*(1), 69–91. http://dx.doi.org/10.1080/1361332052000341006.

Young, P. A. (2008). Integrating culture in the design of ICTs. *British Journal of Educational Technology*, *39*(1), 6–17. http://dx.doi.org/10.1111/j.1467-8535.2007.00700.x.

Update

International Journal of Child-Computer Interaction
Volume 41, Issue , September 2024, Page

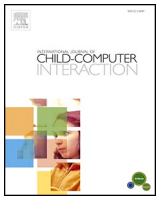
DOI: https://doi.org/10.1016/j.ijcci.2024.100677

International Journal of Child-Computer Interaction 41 (2024) 100677

Contents lists available at ScienceDirect

International Journal of Child-Computer Interaction

journal homepage: www.elsevier.com/locate/ijcci



Erratum regarding missing Declaration of Competing Interest statements in previously published articles

Declaration of Competing Interest statements were not included in the published version of the following articles that appeared in previous issues of International Journal of Child-Computer Interaction.

The appropriate Declaration/Competing Interest statements, provided by the Authors, are included below.

"How block-based, text-based, and hybrid block/text modalities shape novice programming practices" (International Journal of Child-Computer Interaction 17, (2018) 83–92) https://doi.org/10.1016/j.ijcci.2018.04.005. Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Socializers, achievers or both? Value-based roles of children in technology design projects" (International Journal of Child-Computer Interaction 17, (2018), 39–49) https://doi.org/10.1016/j.ijcci.2018.04.004. Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"A comparative study into how pupils can play different roles in co-design activities" (International Journal of Child-Computer Interaction 17, (2018), 28–38) https://doi.org/10.1016/j.ijcci.2018.04.003 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Deepening children's STEM learning through making and creative writing" (International Journal of Child-Computer Interaction 40, (2024), 100651) https://doi.org/10.1016/j.ijcci.2024.100651 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Validating a performance assessment of computational thinking for early childhood using item response theory" (International Journal of Child-Computer Interaction 40, (2024), 100650) https://doi.org/10.1016/j.ijcci.2024.100650 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"The impact of near-peer virtual agents on computer science attitudes and collaborative dialogue" (International Journal of Child-Computer Interaction 40, (2024), 100646) https://doi.org/10.1016/j.ijcci.2024.100646 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Children's approaches to solving puzzles in videogames" (International Journal of Child-Computer Interaction 40, (2024), 100635) https://doi.org/10.1016/j.ijcci.2024.100635 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Making the invisible visible: Youth designs for teaching about technological and algorithmic bias" (International Journal of Child-Computer Interaction 39, (2024), 100634) https://doi.org/10.1016/j.ijcci.2024.100634 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Children's engagement during shared reading of ebooks and paper books: A systematic review" (International Journal of Child-Computer Interaction 39, (2024), 100632) https://doi.org/10.1016/j.ijcci.2023.100632 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Making as an opportunity for classroom assessment: Canadian maker educators' views on assessment" (International Journal of Child-Computer Interaction 39, (2024), 100631) https://doi.org/10.1016/j.ijcci.2023.100631 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

DOIs of original article: https://doi.org/10.1016/j.ijcci.2023.100622, https://doi.org/10.1016/j.ijcci.2023.100621, https://doi.org/10.1016/j.ijcci.2023.100612, https://doi.org/10.1016/j.ijcci.2018.04.004, https://doi.org/10.1016/j.ijcci.2023.100574, https://doi.org/10.1016/j.ijcci.2018.04.003, https://doi.org/10.1016/j.ijcci.2024.100646, https://doi.org/10.1016/j.ijcci.2024.100634, https://doi.org/10.1016/j.ijcci.2023.100631, https://doi.org/10.1016/j.ijcci.2018.04.005, https://doi.org/10.1016/j.ijcci.2023.100632, https://doi.org/10.1016/j.ijcci.2023.100596, https://doi.org/10.1016/j.ijcci.2023.100594, https://doi.org/10.1016/j.ijcci.2023.100618, https://doi.org/10.1016/j.ijcci.2023.100583, https://doi.org/10.1016/j.ijcci.2023.100581, https://doi.org/10.1016/j.ijcci.2023.100578, https://doi.org/10.1016/j.ijcci.2024.100651, https://doi.org/10.1016/j.ijcci.2024.100635, https://doi.org/10.1016/j.ijcci.2023.100620, https://doi.org/10.1016/j.ijcci.2023.100601, https://doi.org/10.1016/j.ijcci.2023.100575, https://doi.org/10.1016/j.ijcci.2024.100650, https://doi.org/10.1016/j.ijcci.2023.100614, https://doi.org/10.1016/j.ijcci.2023.100591, https://doi.org/10.1016/j.ijcci.2023.100576, https://doi.org/10.1016/j.ijcci.2023.100566, https://doi.org/10.1016/j.ijcci.2023.100564, https://doi.org/10.1016/j.ijcci.2023.100602, https://doi.org/10.1016/j.ijcci.2022.100563.

https://doi.org/10.1016/j.ijcci.2024.100677

Available online 22 July 2024

""Hey, Alexa" "Hey, Siri", "OK Google" …." exploring teenagers' interaction with artificial intelligence (AI)-enabled voice assistants during the COVID-19 pandemic" (International Journal of Child-Computer Interaction 38, (2023), 100622) https://doi.org/10.1016/j.ijcci.2023.100622 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Towards culturally sustaining design: Centering community's voices for learning through Participatory Design" (International Journal of Child-Computer Interaction 39, (2024), 100621) https://doi.org/10.1016/j.ijcci.2023.100621 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Stimulating preschoolers' early literacy development using educational technology: A systematic literature review" (International Journal of Child-Computer Interaction 39, (2024), 100620) https://doi.org/10.1016/j.ijcci.2023.100620 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"AMBY: A development environment for youth to create conversational agents" (International Journal of Child-Computer Interaction 38, (2023), 100618) https://doi.org/10.1016/j.ijcci.2023.100618 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Fast mapping in word-learning: A case study on the humanoid social robots' impacts on Children's performance" (International Journal of Child-Computer Interaction 38, (2023), 100614) https://doi.org/10.1016/j.ijcci.2023.100614 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Shimpai Muyou: Confronting Child Suicides in Japan through a Serious Game & School-based Intervention" (International Journal of Child-Computer Interaction 38, (2023), 100612) https://doi.org/10.1016/j.ijcci.2023.100612 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Making computing visible & tangible: A paper-based computing toolkit for codesigning inclusive computing education activities" (International Journal of Child-Computer Interaction 38, (2023), 100602) https://doi.org/10.1016/j.ijcci.2023.100602 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"ScratchJr design in practice: Low floor, high ceiling" (International Journal of Child-Computer Interaction 37, (2023), 100601 https://doi.org/10.1016/j.ijcci.2023.100601 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"A codesign study exploring needs, strategies, and opportunities for digital health platforms to address pandemic-related impacts on children and families" (International Journal of Child-Computer Interaction 37, (2023), 100596) https://doi.org/10.1016/j.ijcci.2023.100596 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Child-home interaction: Design and usability evaluation of a game-based end-user development for children" (International Journal of Child-Computer Interaction 37, (2023), 100594) https://doi.org/10.1016/j.ijcci.2023.100594 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"From endpoints to trading zones: Multi-directional exchange for computational empowerment in computer science education" (International Journal of Child-Computer Interaction 37, (2023), 100591) https://doi.org/10.1016/j.ijcci.2023.100591 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Making a Makerspace for children: A mixed-methods study in Chinese kindergartens" (International Journal of Child-Computer Interaction 36, (2023), 100583) https://doi.org/10.1016/j.ijcci.2023.100583 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"How Does Constructive Feedback in an Educational Game Sound to Children?" (International Journal of Child-Computer Interaction 36, (2023), 100581) https://doi.org/10.1016/j.ijcci.2023.100581 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Assessment of learning in child–computer interaction research: A semi-systematic literature review" (International Journal of Child-Computer Interaction 36, (2023), 100578) https://doi.org/10.1016/j.ijcci.2023.100578 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"The situated power of computational empowerment" (International Journal of Child-Computer Interaction 36, (2023), 100576) https://doi.org/10.1016/j.ijcci.2023.100576 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Students' achievement goals: Goal approximation, engagement, and emotions in co-design activities and product" (International Journal of Child-Computer Interaction 36, (2023), 100575) https://doi.org/10.1016/j.ijcci.2023.100575 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Investigating primary school children's embodied expression of programming concepts" (International Journal of Child-Computer Interaction 36, (2023), 100574) https://doi.org/10.1016/j.ijcci.2023.100574 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Systematic mapping of computational thinking in preschool children" (International Journal of Child-Computer Interaction 36, (2023), 100566) https://doi.org/10.1016/j.ijcci.2023.100566 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Digital Media and Bildung—In memoriam of Heidi Schelhowe" (International Journal of Child-Computer Interaction 36, (2023), 100564) https://doi.org/10.1016/j.ijcci.2023.100564 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in this paper.

"Effects of a computational thinking intervention program on executive functions in children aged 10 to 11" (International Journal of Child-Computer Interaction 35, (2023), 100563) https://doi.org/10.1016/j.ijcci.2022.100563 Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work in

this paper.