

# Analysing the Usage and Acceptance of You and Your Baby, an MHealth solution in two resource-constrained communities

Rinya Singh

University of Cape Town

## ABSTRACT

The Bhabhisana Baby Project (BBP) is a Western Cape NGO that has been involved in co-design efforts with University of Cape Town students to develop and deploy a mobile application called You and Your Baby. This application offers the NGO's beneficiaries a platform to access video and PDF content assigned to them by the trained staff at the BBP. This project aims to monitor and analyse the usage of the You and Your Baby mobile application amongst the BBP's beneficiaries and a different community in Sweetwaters, Kwa-Zulu Natal, as well as attempt to analyse the adoption of the technology. This paper presents the user interviews, workshops and analytics data and identifies the important factors contributing to the acceptance of the You and Your Baby app in the developing contexts of the two South African communities.

## 1 INTRODUCTION

### 1.1 Project Context

The broader project undertaken by the Honours students of 2023 seeks to re-engineer the existing system to create a version that can be efficiently maintained by subsequent researchers. The refactored You and Your Baby application has been deployed, in collaboration with the Human Sciences Resource Council of South Africa, to a group of parents in Sweetwaters, KwaZulu-Natal (KZN), and the entire You and Your Baby system (including the admin portal) has been deployed to the original community of the BBP.

This paper presents the application of the UTAUT-2 model to the case of a mHealth solution in two under-resourced, bandwidth-constrained communities. This, along with the analysis of usage data, will provide insights into the key factors influencing the acceptance of mHealth solutions in developing contexts.

### 1.2 Research Aims

This paper seeks to investigate whether a mobile application, co-designed to support parents with children who have developmental challenges, is useful and usable for the community of mothers.

Secondly, this paper will investigate the variations in acceptance of the You and Your Baby application between the community that was actively involved in the co-design process (the BBP) and a community that was not involved in the co-design process (Sweetwaters).

Lastly, this study will apply the Unified Theory of User Acceptance of Technology-2 (UTAUT-2) [46] to analyse the adoption of the You and Your Baby application in the two communities and identify the key factors determining its acceptance.

## 2 BACKGROUND AND RELATED WORK

### 2.1 Early Childhood Development (ECD)

Early Childhood Development, or ECD, refers to the period of a child's critical development between birth and around three years of age. These initial 1000 days play a pivotal role in the child's future development[22]. Unfortunately, resource constraints within the South African public healthcare system cause prolonged intervals between the diagnosis and treatment initiation for children facing developmental challenges[34].

### 2.2 Mobile Health (mHealth)

Mobile health (mHealth) applications represent a popular use of technology to solve a range of problems. The use of mHealth applications by mothers has shown to increase their skills in child-rearing and monitoring [12], as well as being effective in assisting parents in encouraging healthy eating behaviours in their children [1].

### 2.3 You and Your Baby 2022

You and Your Baby is a mHealth application deployed by 2022 University of Cape Town Honours students as the result of a co-design process between the university and the BBP [9, 29, 40] exhibited many issues that rendered it unusable by the BBP. These issues included videos being unplayable on the mobile app and the need for constant synchronisation to pull new content. The BBP staff found the admin panel unintuitive and difficult to use, making uploading of new content inefficient. This inefficiency of application use is a usability constraint that affects the end users' usage of the application [27].

### 2.4 Technology Acceptance Models

The acceptance of a new technology into a community is reliant on a wide variety of factors, of which only a few have been formalised by scholars. While usage data garnered from application downloads can provide valuable quantitative data surrounding the application's popularity, further insights into users' motivations can be useful in developing better design methods[13]. These frameworks lay out differing factors proposed to affect a technology or software's acceptance by a community. The resulting insights can allow changes to be made to the technology in question to improve the technology's usage.

However, each framework has its own weaknesses and strengths that should be taken into account when choosing a model to apply to a specific case study [6]. This section will discuss the popular frameworks for explaining technology acceptance and examine whether or not they can be applied to the context of under-served, resource-constrained South African communities.

**2.4.1 Technology Acceptance Model.** The Technology Acceptance Model(TAM), presented by Fred Davis in 1985 is one of the

first models to predict and explain factors affecting a technology or software's acceptance by the target audience [11]. The TAM presents perceived usefulness, the perceived ease of use and the users' attitude towards the technology as influencing the users' behavioural intention. In other words, the TAM seeks to understand the users' intention to perform the behaviour of using the technology. The users' perception of the technology in question is particularly important in the TAM.

However, the TAM has encountered critique for its inherent inability to comprehensively describe users' uptake and integration of new technologies into their routines. The model was initially proposed in the early 1980s and struggles to accurately predict and explain consumer behaviour posed by the modern rapid pace of technological advancement [6], making the TAM less accurate under present-day circumstances. A study by Averweg [5] found that perceived usefulness is not more strongly related with usage than ease of use. The TAM, however, emphasises that perceived usefulness is more strongly correlated with usage [11], thus implying inaccuracies in the underlying theory of the TAM. Specifically, the TAM does not take into account the nuances of technology acceptance in developing countries, [30], thus making the TAM an insufficient model with which to explain the usage of the You and Your Baby application.

**2.4.2 Unified Theory of Acceptance and Use of Technology (UTAUT).** The UTAUT is a widely accepted as a unified theory that takes inspiration from the TAM and similar theories that can be applied to various scenarios and software [45]. The UTAUT, first proposed in 2003, attempts to combine the approaches of eight popular TAMs of determining user acceptance and succeeds in being applicable to varied contexts [45]. The four factors identified by the UTAUT as predicting intention to use a technology are:

- Performance Expectancy: the degree to which the user believes that the system will assist them reach their goals—whether job-related or otherwise. This factor is moderated by the user's gender and age.
- Effort Expectancy: the degree to which the user perceives the system as being easy to use. This factor is moderated by the user's gender, age and experience.
- Social Influence: the degree to which the user perceives that other individuals who are important to them will react to their use of the system. This factor is moderated by the user's gender, age, experience and the voluntariness of their usage of the system.
- Facilitating Conditions: the degree to which the user believes that organisational and technical infrastructure exists to support their use of the system. This factor is moderated by the user's gender, age and experience.

This model was further improved upon by the original researchers to add three constructs- hedonic motivation, price value and habit:

- Hedonic Motivation: the enjoyment a user derives from using the technology. Moderated by age and gender of the user.
- Price Value: the user's perceived overall benefit or loss as a result of whatever monetary cost there is to using the system. Moderated by age, gender and experience of the user.

- Habit: the extent to which people learn to perform behaviours automatically. Moderated by the age, gender and experience of the user.

The UTAUT2 is proposed to be more effective at encapsulating more of the nuance regarding the prediction and explanation of a software's acceptance into a certain community [46].

Despite the useful extensions in the UTAUT2 provides to improve its ability to explain user behaviour, certain nuances still require the addition of moderating factors to explain the impact of culture on technology acceptance [19].

**2.4.3 Diffusion of Innovations.** The Diffusion of Innovations, proposed by Everett Rogers in 1962, is another framework that explains the process of the spread and adoption of new technologies [31]. According to this theory, technology spreads and is adopted in stages, with early adopters leading the way and the laggards adopting it later. The factors proposed to affect this process of adoption are:

- relative advantage: the degree to which an innovation is perceived as being better than the idea it seeks to replace
- Compatibility: the degree to which the innovation aligns with the values of the time, the prior experiences and the essential needs of the potential users
- Complexity: how difficult the innovation is to understand
- Trialability: the degree to which the innovation allows for experimentation or testing before the decision to adopt the innovation is made
- Observability: the degree to which the innovation shows tangible results

This approach, however, does imply a foundational level of technological skill and access to resources. These assumptions are not applicable in developing countries, much less in the low-resourced contexts this study examines. These inherent limitations of the framework have lead to the development of *inclusive innovation* [8] as a better approach to the development and diffusion of innovations in developing contexts.

In the case of the You and Your Baby application, the rural South African context means that we cannot assume the universal baseline of technological aptitude and access to resources.

**2.4.4 Kleine's Choice Framework.** The Choice Framework, proposed by Dorothea Kleine in 2010, presents a novel framework that considers the nuances evaluating the usefulness and impact of Information and Communications Technologies for Development (ICT4D) [21]. This framework is presented as a way to operationalise Amartya Sen's capability approach [35] to apply specifically to ICTs created and used to further development. Kleine does this by including work done by Alsop and Heinsohn to create a framework for measuring empowerment at policy level [3] and parts of the Sustainable Livelihood Framework [15] developed by the United Kingdom's Department for International Development.

The Choice Framework thus does well at creating a new framework that centers the user's ability to use technology and takes into account some nuances of life in a developing country.

However, for the purposes of this paper, the Choice Framework does not adequately address the issues pertaining to the technology

itself- such as the ease of use noted by models such as the TAM [11].

## 2.5 Model Selection

The UTAUT2 model has been found, through a linear study of many popular technology acceptance models, to have better explanation power than the others [32].

## 3 THEORETICAL FRAMEWORK

This section provides an introduction to Information and Communication Technology for Development (ICT4D) to establish the lens through which the UTAUT-2 framework is examined in South Africa.

### 3.1 Introduction to ICT4D

ICT4D is a field concerned with the use of ICTs to support or enable various development initiatives. The field had its beginnings in the information sciences in roughly the 1980s [47]. mHealth applications, specifically, provide powerful method by which equalisation can be achieved. These applications are integral in reducing healthcare disparities across rural and urban areas, as well as improving health awareness across communities [10, 38]. There are, however, challenges faced by ICT4D researchers when it comes to introducing these technologies in developing countries.

### 3.2 Challenges with ICT4D in developing countries

Specific challenges faced by ICT4D in developing countries include:

- uncertainty
- Resource constraints
- inequality
- institutional differences
- localism

[17, 33]. The use of digital applications for mHealth has been shown to increase efficiency of health systems [25]. However, the exorbitant costs of data and coverage issues in South Africa [2] make leveraging these interventions difficult. Additionally, residents of rural areas experience inadequate network coverage [23] and do not have excess mobile data [28]. Given that poor internet connectivity negatively impacts mHealth adoption [20], the ability of end-users to adopt and use a technology is hampered.

### 3.3 Applying the UTAUT-2 to developing countries

This section will explore the application of the UTAUT-2 to the case of You and Your Baby's deployment in and propose which factors from the original model will have the most impact on the adoption of the application.

3.3.1 *Facilitating Conditions.* Facilitating conditions are the extent to which an individual believes that infrastructure- both at an organisational and a technical level- to ensure that the user can successfully use the system [45]. Similarly, the factor of *structure* in the Choice Framework refers to the resources that an individual

has access to that can aid them in using technologies and gaining information [21].

As previous research surrounding ICTs in developing countries has found, resource constraints and other context-specific issues complicate the deployment and usage of these technologies [7]. In the case of You and Your Baby and the South African context, the level of access to technology, internet connectivity and experience with technology are important facilitating conditions for use of the application.

Users require access to an internet connection in order to view and download videos and articles- something that is specifically difficult to acquire in the South African context, where people in rural areas regularly have insufficient storage space and inadequate network coverage [23]. These issues affect the users' ability to make full use of the technology in question, as if the users only have sporadic access to internet access, their ability to use that technology will be limited, as it would be if their internet access is expensive.

It is thus proposed that one of the major factors impacting the acceptance of the You and Your Baby application will be the facilitating conditions- both technical and infrastructure-related.

3.3.2 *Social Influence.* This factor refers to the impact that norms, pressure and influence have on users' decision to accept the technology. This is of specific interest in the communities in this study as there are specific cultural norms such as *hloniphisa*- a cultural politeness phenomenon [26] found in South Africa and other African countries in both use of language and cultural practice [16, 24].

A previous study has also noted the possible existence of power disparities between men and women that need to be considered when engaging with the communities in Athlone and Sweetwaters [42]. Importantly, cultural values on technology also affect users' acceptance of and interaction with technology [18].

3.3.3 *Habit.* Habit, in the case of this mHealth solution, refers to the extent to which the users have been able to integrate the use of the app into their daily routines. Specifically in the case of caregivers, their care-giving roles will always take precedence and the technology has to be compatible with specific needs such as one-handed use while breastfeeding or comforting a child [48]. The caregivers need to be able to allocate time to technology use and provide a tangible benefit.

3.3.4 *Hedonic Motivation.* Hedonic motivation has been found to be a significant predictor of the intention to use mHealth applications [14]. This can be applied to the You and Your Baby app by considering the level of enjoyment caregivers obtain from the content or the satisfaction they experience after successfully using the app to better take care of their children. Users may also derive satisfaction from using the app should the content prove to benefit them or their children.

## 4 PROCEDURES AND METHODS

This section will outline the ethical considerations of this study, the contexts of the research sites and the procedures followed during the interactions with participants, as well as describe the analytics features implemented in the You and Your Baby application.

## 4.1 Ethics

Ethics clearance was obtained for the workshops with human participants from the Faculty of Science Research Ethics Committee (FSREC). Consent forms that explained the nature of the study and the involvement required by the participants were distributed and signed by all participants. All data collection- audio recordings, photo recordings and analytics data about application usage- was compliant with the POPI Act.

## 4.2 Research Context

The deployment of the You and Your Baby application took place in two separate sites that differ not only in geographical location, but have important cultural, language and income differences.

**4.2.1 Bhabhisana Baby Project.** The first research site is that of the Bhabhisana Baby Project (BBP). The BBP is a NGO started by skilled therapists who noticed a lack of ECD support for parents of young children with developmental difficulties in under-resourced South African communities [4]. The beneficiaries of this organisation are parents dependent on public healthcare and would not otherwise be able to afford such services. They provide counselling and therapy sessions and are seeking to leverage the You and Your Baby application to offer parents educational video and PDF content, complementing the impact of their in-person therapy sessions. The BBP is based in Athlone, Cape Town, an area that is zoned as urban, with a monthly income of around 4,775 ZAR per month and a population of roughly 33,314 people. 59% of Athlone's residents are English speakers, followed by 29% Afrikaans speakers and 8% isiXhosa <sup>1</sup>.

The beneficiaries of this organisation have been involved in the co-design of the You and Your Baby application and are its intended end-users.

**4.2.2 Sweetwaters.** The You and Your Baby application was also deployed for use by caregivers of children in Sweetwaters, KZN. Sweetwaters is 97Km outside Pietermaritzberg in the uMgungundlovu district. The household income is 2,400ZAR per month <sup>2</sup>. The population is around 600 000 people, with 100% of the population being Zulu speakers.

The Sweetwaters participants of this study were not involved in the co-design of this application and do not have children with developmental difficulties. They were provided a version of the application with general ECD content.

## 4.3 Analytics Features

To enhance understanding of the usage of the You and Your Baby application, we needed to incorporate custom events through Firebase Analytics.

This allowed the researchers to capture and analyse specific user interactions with the application. These custom events were created to gain deeper insights into user engagement and thus allow for more improvements to be made for the app. This information could also be provided to the staff members of the BBP to assist them in

<sup>1</sup><https://wazimap.co.za/profiles/ward-19100049-city-of-cape-town-ward-49-19100049/>

<sup>2</sup>[statssa.gov.za/publications/P0318/P03182019.pdf](http://statssa.gov.za/publications/P0318/P03182019.pdf)

tracking which beneficiaries had watched videos and whether or not they had watched assigned content.

The initial step to implement custom events was the integration of Firebase Analytics by configuring the Firebase Analytics SDK within the project.

A set of custom events and parameters were then defined that allowed for the collection of specific data points. These custom events are:

- **select\_content(video\_card)** is logged when the video card is clicked on the main dashboard
- **select\_content(article\_card)** is logged when the article card is clicked on the main dashboard
- **pdf\_opened(username, item\_name: PDF OPENED, pdf\_title)** is logged when a user opens a PDF
- **video\_played(username, video\_name)** is logged when a user starts playing a video
- **video\_play\_completed(username, video\_name)** is logged when a user watches a video
- **video\_watched(username, video\_name, watch\_duration)** is logged when a user watches only part of a video- either by pausing it or pressing the back button
- **download\_video(user, video\_name)** is logged when a user downloads a video

The analytics features were tested thoroughly through the use of Firebase's DebugView, which allows for the data being sent to Firebase Analytics to be verified for a short period of time. In order to prevent any false data points from being reflected, the analytics features were simply commented out or removed during testing of the app. The overall usage graphs of the application are presented in this paper as well as the results of qualitative investigations in order to support data triangulation.

## 4.4 Data Triangulation

Gaining a comprehensive understanding of the usage of the You and Your Baby application required the collection of both quantitative and qualitative data. Qualitative data was gathered through workshops and interviews with the BBP staff, beneficiaries and the caregivers in Sweetwaters, whereas quantitative data in this study takes the form of analytics from Firebase Analytics. The collection of these two types of data allowed for findings to be validated across data types.

## 4.5 Workshops

The You and Your Baby app was deployed at two research sites- at the BBP and in Sweetwaters. This section provides some details around the workshops, with more participant information available in Table 1 in the Appendix.

**4.5.1 Initial Staff Meeting at BBP.** The first meeting with two members of staff at the BBP offices in Cape Town. This meeting took place with two staff members, two of the three honours students and Ryan Oet, a postgraduate researcher studying the usage of the You and Your Baby 2022 application since its initial deployment. This served as an introductory session where the honours researchers explained our plan for the rest of the project. This session also

served as an introduction to the NGO, the services they offer and context for the community they serve.

**4.5.2 Initial Caregiver Workshop.** This workshop took place at the offices of the BBP, in collaboration with another postgraduate researcher. Three female caretakers and two male caretakers were involved. These caretakers were beneficiaries of the BBP and had been part of the initial deployment of the You and Your Baby application.

**4.5.3 Follow-up Caretaker Workshop.** This workshop was also held in-person, with five participants present. Four of the participants were female and one was male. Some of these participants were also part of the initial workshop and the others had been part of the ongoing collaboration with Toshka Coleman and the 2022 Honours group as well.

This workshop was held over four hours on a Saturday. Although the researchers had planned a longer workshop, the session was shortened as the staff advised that the caretakers would not be able to give up more time. This meant that our plan had to be shortened, with some sections, such as final focus groups, having to be removed.

**4.5.4 Caregiver Workshop in Sweetwaters, KZN.** This workshop took place over two days (29 and 30 July) at the Human Sciences Research Council (HSRC) offices in Sweetwaters, KZN. The nine participants were recruited by the HSRC and there were eight participants present at either day of the workshops. The participants were introduced to the You and Your Baby application, with the researchers engaging in rapid prototyping of the application so as to build affinity for the application through co-design. The usage of the application in Sweetwaters was monitored through Firebase Analytics after the deployment.

The participants for both days of the workshop were based on a convenience sampling approach, as a fellow researcher from UCT's Human-Computer-Interaction Lab was able to recruit the same participants as her PhD group. Nine participants were recruited and due to scheduling conflicts, we ended up with eight, all-female participants on either of the two days. These participants were all already familiar with each other, with some of them even related to each other and others friends, neighbours or co-workers.

The researchers, in collaboration with the Human Sciences Research Council of South Africa (HSRC), arranged for a two-day workshop over the 29th and 30th of July in Sweetwaters, KwaZulu Natal. The purpose of this workshop was to introduce participants from the community to the You and Your Baby mobile application and website as a case study to monitor their usage of the mobile application. Sweetwaters is a rural community that has decent network connectivity due to its proximity to the more affluent town of Hilton [41].

## 5 FINDINGS

### 5.1 Bhabhisana Baby Project

The following section details the workshops conducted by the researchers with caregivers who receive support from the BBP. Quotes from staff members are denoted by either SM-A or SM-B and quotes from participants with P(number).

**5.1.1 Caretaker workshop- May 2023.** This workshop was conducted in conjunction with another postgraduate researcher investigating the usage of the You and Your Baby application.

This workshop consisted of discussions with the caretakers and staff about the co-design process, the application as it had been deployed in 2022 and their issues with the application. Some of the caretakers had been using the application since its release, whereas the others had not used it before the workshop.

The workshop began with general thoughts about the application from the participants who had been using the application. Their major complaints centered around the app's technical issues such as "P3: *it shows no content in the categories*" or "P2: *when I downloaded the app I couldn't get in [to the app]*". These usability issues were associated with the deployment of the 2022 app.

Another issue brought up was the limited number of languages that the content on the app is available in. Specifically, one participant reported that her baby was in Zimbabwe, being cared for by her mother. This participant wanted to send some of the childcare videos to her mother, but notes that "P1: *[she] doesn't speak English or the Xhosa*" used in the videos. The staff members commented that this could present an opportunity for "SM-A: *[the parent to] talk in [her] own language and make a little video for her [mother]. And that could be very useful on this app [as other Shona speakers would benefit as well]*".

Aside from the usability issues that prevented the BBP's beneficiaries from using the app regularly, the participants were overwhelmingly positive in their feedback for the app and the future potential of the app. Two participants, a married couple, noted that "P1: *[our] baby is in Zimbabwe. But I can get information from [the app] and send it to the [person] taking care of my baby*" and "P1: *the app also teaches a lot of things [about childcare]*". This indicates that the information provided by the BBP to their beneficiaries via the app is necessary and useful to the beneficiaries to the extent that the beneficiaries will want to share information with family members with whom they split care-giving duties. Another participant echoed the need to share the ECD information with others and reported that "P2: *I wanna give [the video] also to my mom, she help[s] me with [taking care of my child]*" and wanted to give her mother access using her password. The idea of sharing childcare with others- usually family members- was very common across these participants.

This reliance on family or community members was reported as being particularly prevalent when one of their children (usually the child with developmental difficulties) was admitted to the hospital. One participant emphasised that she often needs to rely on her mother to take care of her other children while she accompanies one of her children to the hospital and expressed that "P4: *they say it takes a whole village to raise a child*". This participant reported that she did feel guilty when asking her mother to take care of her children but recognised that "P4: *[she doesn't] have a choice because [she has] to go to work*".

Other participants were able to empathise with the feelings of guilt when relying on family members for assistance with childcare. Another participant, whose child was born **three months** premature, recounted his difficulties when "P5: *[he had to go] a lot in and out [of] the hospital and then [I had] another two kids at home*". During these difficult times, the participants expressed that

having videos from other parents on the You and Your Baby app where the parent would encourage other caregivers by “P4:*tell[ing] [their] story*” and perhaps offering advice on how to handle such trying situations, would be of help. The staff members encouraged the participants to consider filming such videos and to ask their older children (such as participant P2, whose daughter is in matric this year) to film videos about their experiences with taking care of their siblings.

Overall, the participants were in agreement that “SM-A: *there are so many stories and [the stories] would be so helpful for other parents because [your family members] are affected somehow*”. This idea of the caregivers creating video content to share with other BBP beneficiaries via the You and Your Baby app was explored by researchers in the follow-up workshop in August.

**A topic of discussion brought up by the caretakers was social stigma around developmental difficulties.** Staff and participants noted that there was a need for more videos on the application filmed by the BBP’s beneficiaries to try and inspire, encourage and educate other parents- particularly those with children with developmental difficulties.

Overall, the caretakers and staff shared positive feelings about the application and agreed that they would use the application even if the usability issues were not resolved.

**5.1.2 Follow-up Caretaker workshop- August 2023.** This follow-up workshop with BBP’s beneficiaries was also held at the BBP’s offices. These workshops involved four female caretakers and one male caretaker, of which two had children older than six years old who had “graduated” from the BBP program. These two parents have been active in the You and Your Baby co-design initiative from its inception, regardless of the fact that they no longer directly benefited from the services offered by the BBP.

The first section of the workshop was dedicated to a general discussion about the caretakers’ demographics, how many children they had and what their routines were like. Almost immediately, the idea of support systems was brought up, with a participant crediting her mother and sisters with helping her take care of her three kids. According to her, “P1: *you can take life on [with a support system]*”. However, the same participant reported, “P1: *I don’t have friends. I’m twenty four seven in the house*”, as a result of her priorities being centered wholly on her child, who has cerebral palsy and epilepsy. Other participants echoed that they felt like they “P2: *need me me time!*” away from their households and responsibilities. Participants also brought up their experiences with encouraging other parents, noting that these interactions were useful in supporting and **empathising with**

The staff members are keenly aware of this isolation experienced by their beneficiaries and cite the annual parties that they throw as one of the few “SM-A:*opportunities [to socialise]... [the parents] don’t really get opportunities when they come for therapy to meet other people*”. This feeling of separation from society and family is deemed an “SM-A: *isolated pain*”.

Similarly to the first workshop, the concept of familial support was brought up again, with a participant calling her three children “P2: *my team... who support me and support each other*”. This participant is a single mother and faces many stressors, including the challenges of one of her children being in matric. Regardless of

these issues, participants agreed that the support they gained from the BBP played an instrumental roles in their lives and helped them greatly with taking care of their children.

Two out of five participants reported having WiFi access at their homes, whereas three did not. Of these three, one was a small business owner who “P3: [does] everything on [her] phone- calls, WhatsApp video calls” and thus estimates that she spends R100 a week on airtime.

When asked what they used their phones for, one participant brought up social media, but another immediately reported using his phone to look up “P3: *medical jargon*” that healthcare workers were using whilst diagnosing his child with issues such as aspiration. This was later used in the content creation session to guide ideation. Overall, the participants reported being relatively familiar with social media and phone apps.

The next step in the workshop was a cognitive walk-through of the You and Your Baby app. The researchers sent an APK for the app to one of the BBP staff members over WhatsApp, after which the staff member forwarded it to the participants. Three out of five participants had Samsung phones and were able to install the app with little help. An unexpected hurdle presented itself, however, came in the form of two out of five participants and one staff member using Huawei phones. Installing the APK from the WhatsApp download was not successful and the researchers ended up having to send the APK over Bluetooth. Due to server constraints of the website’s hosting capabilities, participants were not able to all log in to the app at the same time. The website was only active for certain points in the workshop. The participants were given access to the app using a generic workshop account, *BBPUser*, and provided with their personal accounts for use after the workshop. The participants found the mobile app mostly intuitive and were easily able to point out additional features they wanted. One participant pointed out that “P4: *there’s so many things... it might be nice to have a search button [for the content]*”. Another pointed out that “P5: *some [parents] don’t like videos*” and suggested that articles may be more useful for situations when she or another parent doesn’t have headphones and are in a public space. A staff member noted that there is “SM-B: *no way of knowing [if the content] is a video or an article*”, meaning that the content cards needed to have icons that categorised them as videos or articles. In terms of the visual appeal of the app, all participants and staff members insisted that the Bhabhisana logo, a purple butterfly, needed to appear on the app. This was an issue brought up in the initial workshop and speaks to the strong association the beneficiaries of the BBP have with the logo, the BBP and You and Your Baby as an extension of the services offered by the NGO. The staff members found the use of yellow as the background colour “SM-B: *nice and bright*” and expressed that “SM-A: *the orange would [look] better as yellow*”, later expressing that the background for the whole app should be yellow. Additionally, staff members suggested that the icons for content categories- at the time, graphic icons of babies and baby-related items- should be replaced by photos of actual babies. The participants agreed with these suggestions, and were happy with the overall app in terms of its usability and visual appeal.

## 5.2 Case Study: Sweetwaters

The following are findings from the two-day workshop held in Sweetwaters, KZN. Quotes are denoted with P, followed by a number to differentiate participants.

**5.2.1 Day 1- Caretaker workshop in Sweetwaters.** On the first day, four of our participants were younger women between the ages of twenty and thirty and the other four were older women over the age of sixty. All these women had children or grandchildren who were under the age of four or took care of children of that age. Two out of eight participants were educators, with one of these being a teacher at an ECD center.

The researchers initiated a conversation about the participants' healthcare-seeking practices in the larger group. The questions posed attempted to gain an understanding around their preferred methods of seeking healthcare advice and support, as well as inquiring their level of trust of the internet when it comes to their own and their children's health. The participants mostly agreed that they would visit clinics. P1: "We usually go to clinics [but] it is far". They also frequent medication centers monthly to collect their medication. These centers are P2: "*near by our churches, our schools*" and thus relatively easy to access.

Seven out of eight participants reported that they relied on their family members-particularly their grandmothers- for healthcare advice. One participant, an older teacher at an ECD center, reported that she would prefer to visit a clinic. Overall, clinics were reported as being helpful, trusted, close by but unsafe and inconvenient, with the ECD teacher noting that "*you are coming once a month to your medication center to collect your medication, thereafter*". The participants also noted that they preferred home remedies to medication prescribed from a clinic due to cost constraints. The participant group was overwhelmingly unused to using Google for healthcare advice.

This reliance on family and their neighbours extended to their choice of childcare when they are themselves tired, as all participants said that they would ask a member of family to help with childcare. Researchers then asked questions regarding the amount of airtime they bought in a month. This ranged from R150 to R250 a month. Three out of eight participants would allow their children to watch videos on their phones. Those who wouldn't give their phones to their children noted that this would use up too much data.

The next discussion surrounded technology use and was done in two focus groups. The group of older women reported not using their phones often at all. One of them reported preferring SMS messaging, noting that "*P4: I don't know how to use WhatsApp*". They noted difficulties with using technology, such as "*P2: I went (swiped) that side but I was supposed to go that side*". They also reported not watching television or videos on their phones and preferred listening to the radio whilst engaging in household tasks.

The group of younger women seemed much more apathetic to the discussion, but did report that they enjoyed using their phones to watch TikToks and use WhatsApp.

The researchers then sent the APK of the application to the participants through WhatsApp. Seven out of eight participants had Samsung phones and the other, a tablet. She struggled to download the APK to the tablet and ended up sharing her sister's phone to

use the app Once the researchers had assisted in installation of the application, the participants were re-introduced to the application and asked to interact with it. The tasks given to them included watching videos, uploading videos and looking for PDFs Overall, the older women struggled with completing the tasks and required assistance from the researchers to navigate the app, whereas the younger women completed the tasks easily and quickly. When asked what could be changed to make the app easier for them to use, an older participant exclaimed that "*P4: we don't know how to use these things [apps]*" and that nothing much would help except making the buttons and text on the screens larger so as to be easier to read. The last activity for the day was for the participants to write down ideas for videos that would be filmed for uploading the next day. The broad categories were videos for parents and videos for children. Within these categories, we asked the participants to jot down ideas for self-care videos, healthcare, home remedies, educational videos and entertainment videos. The researchers collected the sticky notes and categorised them, then read the ideas out loud. This activity yielded the following example results:

Videos for parents:

- Educational: dance, showing off talents
- Entertainment: songs, comedy skits and cartoons
- Self-care: hair masks, wearing bright colours, face masks
- Childcare: how to keep them calm, helping them sleep longer, normal motor functions

Videos for children:

- Educational (toddlers): Alphabets, numbers
- Educational (over five years): how to pray, reading
- Entertainment: games, how to do make-up

The full results from this activity can be found in the Appendix (Figure 6- Figure 12).

**5.2.2 Day 2- Caretaker Workshop in Sweetwaters, KZN.** This workshop started with a task-based cognitive walk-through with the participants to do usability testing of the now-updated application. The participants were given three tasks to complete, again in focus groups.

The first task was to watch a video in full screen, which the group of younger participants completed very successfully. The group of older participants, however, struggled and had to ask for assistance from the researchers to complete the task.

The second task was to download a video. This was again completed successfully by the younger participants but not by the older participants.

The third task was to upload a video from their gallery. Again, the older participants required help in completing the task. Only two out of the three of the younger participants were able to complete this task as the upload button was not visible on the third participants' screen. This was a major usability issue fixed during the workshop.

The next segment of the workshop was the content creation. The participants were divided into groups of three or two participants and asked to film a video about their advice for new parents. The participants wrote scripts for themselves to follow and were more

comfortable speaking in isiZulu rather than in English. This was a productive activity with all the participants becoming involved in each others' videos. The second video filmed was 'What's your favourite skincare routine'.

### 5.3 Usage Data Analysis

This section below details the results from the inbuilt Firebase Analytics in the You and Your Baby app.



**Figure 1:** Graph showing overall usage of the application (number of events)

Figure 1 shows the number of users per day on the You and Your Baby app, with the two spikes being easily attributed to workshops held in Sweetwaters (29–30 July) and at the BBP (19 August). The time period between 30 July and 19 August saw low usage from the users in Sweetwaters, with there being a high of 3 users on one day. After the BBP workshop on 19 August, the data presented is for combined usage by BBP beneficiaries and Sweetwaters residents and shows low usage.



**Figure 2:** Graph showing videos watched

Figure 2 shows the number of videos watched per day. There is a noticeable spike for the BBP workshop. Overall, the usage of the app is low, with some smaller peaks between 28 and 29 August and the 3rd of September.

Tables 4 and 5 (see Figure 4 and Figure 5) show the specific videos watched by one specific BBP beneficiary (with username redacted), as well as the videos watched by the generic BBP user account that was used by the participants for during the workshop. The BBP beneficiary also watched certain videos (such as Food to Eat isiXhosa) more than once.

CUSTOM PARAMETER	EVENT COUNT	TOTAL USERS
(total) 6 items	11	2
Immunization And Its Im...	4	2
Food to Eat isiXhosa	2	1
The Road to Health - Cele...	2	1
About The Road to Health...	1	1
Breast Milk Expression A...	1	1
Child Development	1	1

**Figure 3:** Graph showing videos downloaded

CUSTOM PARAMETER	EVENT COUNT	TOTAL USERS
(total) 6 items	14	1
Food to Eat isiXhosa	5	1
Child Development	4	1
Love, Listening and Explaini...	2	1
Breast Milk Expression Afrik...	1	1
Immunization And Its Impor...	1	1
The Road to Health - Celebr...	1	1

**Figure 4:** Table showing videos watched by a specific BBP beneficiary

CUSTOM PARAMETER	EVENT COUNT	TOTAL USERS
(total) 6 items	8	1
Food to Eat isiXhosa	3	1
Breast Milk Expression Afrik...	1	1
Child Development	1	1
Danger Signs in Early Childh...	1	1
Immunization And Its Impor...	1	1
The Road to Health - Celebr...	1	1

**Figure 5:** Table showing videos watched by BBP beneficiaries using generic account

## 6 DISCUSSION

### 6.1 Data Challenges

TRIANGULATION - types of data - challenges of a ]] Although this study aimed to use qualitative usage data as a means to validate the findings from qualitative data analysis, unforeseen circumstances related to software malfunction occurred during and after the Sweetwaters workshops. When testing the app the morning of the workshop on Saturday, 29 July, the researchers realised that

the free cap for Firebase access had been reached, thus limiting our access to the content (which had been stored on Firebase at the time). Although this issue was resolved by temporarily paying for a server upgrade, it is highly likely that this issue prevented analytics data from being sent by the Sweetwaters participants' version of the app. This has resulted in graphical anomalies that have been discarded as part of the analysis as there is no way to recover the real-time tracking of usage for that time period. While this is an issue for analysis, it speaks to the challenge of embedding usage tracking in software and the rapid prototyping of applications in ICT4D. Another issue faced by the analytics approach is that the data is only sent when there is an internet connection.

## 6.2 Acceptance of You and Your Baby: BBP

This section describes the acceptance of You and Your Baby with reference to the UTAUT-2 model factors and serves as a reflection on each factor and the initial expectations of their importance.

### Effort Expectancy

Majority of the workshop participants and beneficiaries of the BBP are relatively young and parents of children mostly under the age of two. This led to majority of the participants of these workshops finding the app's interface simple and easy to use. This is also an expected result of the co-design process as the practice of participatory has been found to increase usability of the resulting technologies [39, 44].

However, only one user was seen to be using the app after the workshops. Since these is usage of the app pby the generic user 'BBPUse', itcan be assumed that some of these participants forgot their personal account details or forgot to use a different account when using the app after the workshop. This can be addressed through communication with beneficiaries and reminders from the BBP staff members.

### Social Influence

The beneficiaries of the BBP are also subject to more social influences that affect not only their attitude towards the app, but also motivate their usage of the app. Specifically, the participants noted that they are often met with disdain or rude behaviour from others as a result of people close to them being uninformed about developmental difficulties. While this was widely reported as being an issue in hospital settings, one participant reported that "P2: *the comments [from her mother about her child's developmental delays... are getting to [her]]*". This social stigma has also been well-documented as existing in other spheres of life such as education [36] and negatively impacts the mental health of the parents of children with developmental difficulties [37]. This is contrary to what was proposed to be true about the factors influencing acceptance in developing countries, as social influence was not considered to be of significant impact at the beginning of this study.

### Performance Expectancy and Habit

The You and Your Baby app provides childcare advice and therapeutic exercises that caregivers can "SM-A: *do in your own time rather than having to go for a... sort of... appointment*", meaning that the app has great potential to extend the BBP's service delivery beyond physical sessions. The app is also useful as a means of communications between the staff members and beneficiaries,

as a participant in the first workshop noted that she "P3: *missed BHabhisana [sessions] for a few months [so the app] will help a lot*".

This is reflected in the usage data as one user (see Figure 4 has re-watched the *Food to Eat Xhosa* video, implying that this specific video has provided a benefit to them. This is expected and supported by the theory of technology as an amplifier in development contexts [43]. The BBP community has a need for accurate childcare advice for their children and the You and Your Baby app presents a great opportunity for the NGO, and any future researchers, to meet that need using this mHealth solution. The performance expectancy of the app can thus be seen as one of the more important factors in encouraging usage. Due to the short-term nature of this study, habit cannot be determined directly from the data collected. It is, however, likely that the benefits that the beneficiaries experience will eventually cause the beneficiaries to develop a habit of using the app.

### Facilitating Conditions

In terms of facilitating conditions, the BBP beneficiaries reported either having access to WiFi at home or, at the very least, at the BBP offices. This is contrary to what the researchers expected and this access to an internet connection and thus, the app, enhances the usefulness of the app to this community [46].

The content creation done during the workshop also presents an opportunity to increase uptake in the future of You and Your Baby as the videos filmed by the participants of the second workshop are

### Price Value

As expected, price valuehas no impact as a result of the app being free to use.

## 6.3 Acceptance of You and Your Baby: Sweetwaters

This section describes the acceptance of You and Your Baby with reference to the UTAUT-2 model factors and serves as a reflection on the UTAUT-2 factors and the initial expectations of their importance. Due to the lack of useful analytics data after the Sweetwaters workshop, the **Performance Expectancy** The content provided to the Sweetwaters workshop participants primarily centered around general ECD content and some videos for entertainment. This proved to be useful for some participants, as they reported that they showed the app's videos to their children as "P2: *it's easy for him to communicate with us when he's happy and he's playing and dancing [after watching the videos]*". The participants also reported that the videos explain things in a simple way that is "P3: *helpful for slow parents*".

### Effort Expectancy

Secondly, the older participants did not ordinarily use their phones to complete many tasks- aside from WhatsApp. A participant reported not watching videos on her phone as it was a P3: "waste of time" as she would rather garden or make tea for her children. The older participants, in their focus group, then said that they had many tasks and that these would usually snowball into each other [one person wants tea then everyone does]. They would rather simply listen to the radio.

those in Sweetwaters mostly rely on in-person contact for healthcare advice. These caretakers are less likely to have to rely on technology for healthcare advice.

**Social Influence** Firstly, the participants were far too interconnected and reliant on their families and communities to *need* an mHealth solution. The younger participants were friends (or, in the case of two participants, sisters) and thus simply asked each other, their mothers or their grandmothers for advice. This was reported- P2: “I just ask my sister... she’s great at giving advice”. The older participants, conversely, had raised children before and would likely be the ones giving advice to others.

#### Facilitating Conditions

##### Hedonic Motivation

##### Price Value

As expected, price value has no impact as a result of the app being free to use.

**6.3.1 Sweetwaters Challenges.** The workshop Sweetwaters encountered a number of difficulties when it comes to creating user affinity and encouraging participants to engage with the researchers in a meaningful way. The younger participants were regularly watching TikToks during activities, meaning that they either were not fully engaged by the activity or the premise of the workshop. In order to gain meaningful responses from participants, researchers had to split the group up into two- one group of the younger women and another of the older women.

The parents were more involved during the filming of the videos, however this can be due to the younger parents being very active TikTok users.

The demographics of the participant group also raised several issues. Mainly, the selection process for the participants was entirely convenience-based as the participants were all involved in ongoing research with a UCT PhD student and regularly involved in other HSRC studies. Although this allowed us to find participants who had children with relative ease, it meant that the participants may not have agreed to participate out of genuine interest in the study itself, but rather due to their ties with the HSRC and UCT. This was clear in the apathy displayed by the participants during the sections of the workshop that pertained directly to the application itself.

## 7 CONCLUSION

In conclusion, this study has provided valuable insights into the complex dynamics of technology acceptance in under-resourced, bandwidth-constrained communities. Our findings demonstrate that while one community embraced the technology due to a true social need for ECD care for children whose developmental difficulties present a unique challenge for their caregivers, the other community found different reasons to use the technology.

The community of BBP beneficiaries are a vulnerable population and recognise the potential of the app to provide them with the early childhood development support that they need. This community found the application to be a valuable supplement to their existing healthcare-seeking practices.

Conversely, in Sweetwaters, while exposed to the same technology, the participants’ usage of the app was not rooted in the same reasons as the BBP beneficiaries. Their usage of the app did not pertain to healthcare as much as the usage of the BBP beneficiaries but rather to the more entertainment-focused aspects of the

content, specifically the children’s entertainment and the content creation aspects.

In the broader context of Information and Communication Technologies for Development (ICT4D), our research contributes to the ongoing dialogue about challenges faced by researchers in developing contexts and provides insights into what it means to introduce the same technology to communities with different needs.

## 8 ACKNOWLEDGEMENTS

I would like to thank my project partners, Lwazi Sibeko and Tariro Banganayi, for their enthusiasm and support throughout this project. I also extend my deepest thanks to my supervisor, Melissa Desnsmore, for her support and wisdom.

## REFERENCES

- [1] Edwin Emeth Delgado-Pérez Mariana Lares-Michel Ismael Edrein Espinosa-Curiel Ada Mabel Vázquez-Paz, Rosa María Michel-Nava. 2022. Parents' mHealth App for Promoting Healthy Eating Behaviors in Children: Feasibility, Acceptability, and Pilot Study. *Journal of Medical Systems* 46 (2022). <https://doi.org/10.1007/s10916-022-01860-w>
- [2] Mpho Moyo Alison Gillwald and Christoph Stork. 2012. *Understanding what is happening in ICT in South Africa*. Technical Report. Research ICT Africa, Workshop 17, VA Waterfront, Victoria Alfred Waterfront, Cape Town, 8001.
- [3] Ruth Alsop and Nina Heinsohn. 2005. *Measuring Empowerment in Practice: Structuring Analysis and Framing Indicators*. The World Bank. <https://doi.org/10.1596/1813-9450-3510> arXiv:<https://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-3510>
- [4] Eric Atmore. 2012. Challenges facing the early childhood development sector in South Africa. *South African Journal of Childhood Education* 2, 1 (2012), 121–140. <https://doi.org/10.4102/sajce.v2i1.25>
- [5] Udo Richard Franz Averweg. 2002. Executive information systems usage : the impact of web-based technologies. (2002).
- [6] Izak Benbasat and Henri Barki. 2007. Quo vadis, TAM? *Journal of the Association for Information Systems* 8 (2007). <https://doi.org/10.17705/1jais.00126>
- [7] M;Du Bowei W;Ho M;Kam M;Nedevschi-S;Pal J;Patra Rabin;Surana S;Fall-K Brewer, E;Demmer. 2005. The case for technology in developing regions. *IEEE Computer Society* 38 (2005). Issue 6.
- [8] Joanna Chataway, Rebecca Hanlin, and Raphael Kaplinsky. 2013. Inclusive Innovation: An Architecture for Policy Development. *IKD Working Paper* 4 (03 2013). <https://doi.org/10.1080/2157930X.2013.876800>
- [9] Tinashe Mukundi Chitamba. 2022. You and Your Baby: M-Health for mothers in poor communities. (2022). [https://projects.cs.uct.ac.za/honproj/cgi-bin/view/2022/chitamba\\_rmruthen\\_swanepoel.zip/assets/img/submissions/mukundi/CHTTIN007.pdf](https://projects.cs.uct.ac.za/honproj/cgi-bin/view/2022/chitamba_rmruthen_swanepoel.zip/assets/img/submissions/mukundi/CHTTIN007.pdf)
- [10] Vital Wave Consulting. 2012. eTransform Africa: Health Sector Study. (March 2012).
- [11] Fred D. Jr David. 1985. *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results*. Ph.D. Dissertation. Massachusetts Institute of Technology.
- [12] Maria Ulfah Kurnia Dewi and Nova Linda Rambe. 2019. The Effect of MHealth to Increase Mother's Skill in Children Growth and Development Monitoring During >36–48 and >48–60 Months. In *Proceedings of the 1st International Conference on Science, Health, Economics, Education and Technology (ICoSHEET 2019)*. Atlantis Press, 159–163. <https://doi.org/10.2991/ahsr.k.200723.040>
- [13] Andrew Dillon and Michael Morris. 1996. User Acceptance of Information Technology: Theories and Models. *Annual Review of Information Science and Technology* 31 (01 1996).
- [14] Luisa Sophie Vervier Andri Calero Valdez-Martina Zieffe Eva-Maria Schomakers, Chantal Lidynia. 2022. Applying an Extended UTAUT2 Model to Explain User Acceptance of Lifestyle and Therapy Mobile Health Apps: Survey Study. *JMIR Mhealth Uhealth* 10 (2022). Issue 1. <https://doi.org/10.2196/27095>
- [15] UK Department for International Development. 1999. Sustainable livelihoods guidance sheets. London: DFID 445 (1999).
- [16] Ingrid Frandrych. 2012. Between tradition and the requirements of modern life: Hloniphia in Southern Bantu societies, with special reference to Lesotho. *Journal of Languages and Culture* 3 (2012), 67–73. <https://api.semanticscholar.org/CorpusID:5266145>
- [17] Martha Garcia-Murillo. 2003. Patchwork Adoption of ICTs in Latin America. *The Electronic Journal of Information Systems in Developing Countries* 15 (October 2003). <https://doi.org/10.1002/j.1681-4835.2003.tb00097.x>
- [18] Mathew Hillier. 2003. The role of cultural context in multilingual website usability. *Electronic Commerce Research and Applications* 2 (2003). Issue 1.

- [19] Safeer Ullah Khan Ikram Ullah Khan, Zahid Hameed. 2017. Understanding Online Banking Adoption in a Developing Country: UTAUT2 with Cultural Moderators. *Journal of Global Information Management (JGIM)* 25 (2017). <https://doi.org/10.4018/JGIM.2017010103>
- [20] Maged N. Kamel Boulos Naveed Anjum-Muhammad Ishaq Javariya Aamir, Syed Mustafa Ali. 2018. Enablers and inhibitors: A review of the situation regarding mHealth adoption in low- and middle-income countries. *Health Policy and Technology* 7 (2018), 88–97. Issue 1.
- [21] Dorothea Kleine. 2010. ICT4WHAT?—Using the choice framework to operationalise the capability approach to development. *Journal of International Development* 22 (2010). Issue 5. <https://doi.org/10.1002/jid.1719>
- [22] Vijay Kumar, Premananda Mohanty, and Minakshi Sharma. 2021. Promotion of Early Childhood Development Using mHealth: Learnings From an Implementation Experience in Haryana. *Indian Pediatrics* 58 (2021), 37–41.
- [23] Mamara Adelaide Bopape Tebogo M. Mothiba-Melissa Densmore Alastair van Heerden Shane A. Norris-Nervo Verdezoto Dias Paula Griffiths Livhuwani Muthelo, Masenyanzi Oupa Mbombi and Nicola Mackintosh. 2023. Reflections on Digital Maternal and Child Health Support for Mothers and Community Health Workers in Rural Areas of Limpopo Province, South Africa. *International Journal of Environmental Research and Public Health* 20 (2023).
- [24] SInfree Makoni. 2015. Introduction: Politeness in Africa. *Journal of Politeness Research* 11, 1 (2015), 1–5. <https://doi.org/10.1515/pr-2015-0001>
- [25] Daniel Msellemu Melania Nkaku Neal Lesh Marc Mitchell, Bethany L Hedt-Gauthier. 2013. Using electronic technology to improve clinical care - results from a before-after cluster trial to evaluate assessment and classification of sick children according to Integrated Management of Childhood Illness (IMCI) protocol in Tanzania. *BMC Med Inform Decis Mak* (2013). <https://doi.org/10.1186/1472-6947>
- [26] A. Neely. 2021. Hloniphapha and health: Ancestors, taboos and social medicine in South Africa. *Africa* 91 (2021), 473–492. Issue 3. <https://doi.org/10.1017/S0001972021000279>
- [27] Jakob Nielsen. 1993. *Usability Engineering*. Elsevier.
- [28] Amreesh Phokeer, Melissa Densmore, David Johnson, and Nick Freamster. 2016. A First Look at Mobile Internet Use in Township Communities in South Africa. Association for Computing Machinery, New York, NY, USA. <https://doi.org/10.1145/3001913.3001926>
- [29] Suvanthat Ramruthen. 2022. Designing an mHealth Application to Improve ECD in Resource-Constrained Communities. (2022). [https://projects.cs.uct.ac.za/honsproj/cgi-bin/view/2022/chitamba\\_ramruthen\\_swanepoel.zip/assets/img/submissions/suvanthat/CSC4002W-FinalPaper-RMRSUV002.pdf](https://projects.cs.uct.ac.za/honsproj/cgi-bin/view/2022/chitamba_ramruthen_swanepoel.zip/assets/img/submissions/suvanthat/CSC4002W-FinalPaper-RMRSUV002.pdf)
- [30] Averweg Udo Richard. 2005. Applicability of the Technology Acceptance Model in Three Developing Countries: Saudi Arabia, Malaysia and South Africa. *Alternation (Durban)* 23 (2005).
- [31] Everett M Rogers. 1962. *Diffusion of Innovations*. Simon and Schuster.
- [32] Francisco Javier Rondan-Cataluña, Jorge Arenas-Gaitán, and Patricio Esteban Ramírez-Correa. 2015. A comparison of the different versions of popular technology acceptance models: A non-linear perspective. *Kybernetes* 44 (May 2015). Issue 5.
- [33] Narcyz Roztocki and H. Roland Weistroffer. 2011). Information technology success factors and models in developing and emerging economies. *Information Technology for Development* 17 (2011)), 163–167. <https://doi.org/10.1080/02681102.2011.568220>
- [34] Alecia M Samuels, Wiedaad Slemming, and Sadna Balton. 2012. Early Childhood Intervention in South Africa in Relation to the Developmental Systems Model. *Infants Young Children* 25 (10 2012). <https://doi.org/10.1097/IYC.0b013e3182673e12>
- [35] Amartya Sen. 1985. *Commodities and Capabilities*. Oxford University Press India.
- [36] Dara Shifrer. 2013. Stigma of a Label: Educational Expectations for High School Students Labeled with Learning Disabilities. *Journal of Health and Social Behavior* 54, 4 (2013), 462–480.
- [37] George H.S Singer, Brandy Ethridge, and Sandra I Aldana. 2007. Primary and secondary effects of parenting and stress management interventions for parents of children with developmental disabilities: A meta-analysis. *Mental Retardation Developmental Disabilities Research Reviews* 13 (2007). Issue 4.
- [38] C. Sinha and D. Garro-Strauss. 2012. Research on ehealth across health systems: Contributions to strengthen a field. *Connecting ICTs to Development: The IDRC Experience* (January 2012), 161–196.
- [39] Marc Steen, M. Manschot, and Nicole Koning. 2011. Benefits of Co-design in Service Design Projects. *International Journal of Design* (August 2011).
- [40] Jonathan Swanepoel. 2022. You and Your Baby: Co-designing an ECD Content Delivery System for a NGO. (2022). [https://projects.cs.uct.ac.za/honsproj/cgi-bin/view/2022/chitamba\\_ramruthen\\_swanepoel.zip/assets/img/submissions/jono/SWNJON004.pdf](https://projects.cs.uct.ac.za/honsproj/cgi-bin/view/2022/chitamba_ramruthen_swanepoel.zip/assets/img/submissions/jono/SWNJON004.pdf)
- [41] Sarina Till. 2023. (jul 2023). Conversation with Sarina Till, PhD student.
- [42] Sarina Till, Jaydon Farao, Toshka Lauren Coleman, Londiwe Deborah Shandu, Nonkululeko Khuzwayo, Livhuwani Muthelo, Masenyanzi Oupa Mbombi, Mamare Bopane, Molebogeng Mothathledi, Gugulethu Mabena, Alastair Van Heerden, Tebogo Maria Mothiba, Shane Norris, Nervo Verdezoto Dias, and Melissa Densmore. 2022. Community-Based Co-Design across Geographic Locations and Cultures: Methodological Lessons from Co-Design Workshops in South Africa. In *Proceedings of the Participatory Design Conference 2022 - Volume 1 (PDC '22)*. Association for Computing Machinery, New York, NY, USA, 120–132. <https://doi.org/10.1145/3536169.3537786>
- [43] Kentaro Toyama. 2011. Technology as amplifier in international development. In *iConference '11: Proceedings of the 2011 iConference*. Association for Computing Machinery, New York, NY, USA, 75–82. <https://doi.org/10.1145/1940761.1940772>
- [44] Timm Teubner Tyler J Noorbergen, Marc T P Adam and Clare E Collins. 2021. Using Co-design in Mobile Health System Development: A Qualitative Study With Experts in Co-design and Mobile Health System Development. *JMIR Mhealth Uhealth* 9 (2021). Issue 11. <https://doi.org/10.2196/27896>
- [45] Viswanath Venkatesh, Michael Morris, Gordon Davis, and Fred Davis. 2003. User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly* 27 (09 2003), 425–478. <https://doi.org/10.2307/30036540>
- [46] Viswanath Venkatesh, James Thong, and Xiu Xu. 2012. Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly* 36 (03 2012), 157–178. <https://doi.org/10.2307/41410412>
- [47] Geoff Walsham. 2017. ICT4D research: reflections on history and future agenda. *Information Technology for Development* 23 (2017), 18–41. Issue 1. <https://doi.org/10.1080/02681102.2016.1246406>
- [48] Chelsea-Joy Wardle, Mitchell Green, Christine Wanjiro Mburu, and Melissa Densmore. 2018. Exploring Co-Design with Breastfeeding Mothers. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12. <https://doi.org/10.1145/3173574.3174056>

## A APPENDIX

**Table 1:** Workshop specifics

Research Site	Date	Number of Participants	Demographics
BBP	10 May 2023	7	5 women (4 black women, 1 coloured woman) and 2 men
Sweetwaters	29-30 July 2023	9 total	8 women on either day (all black women)
BBP	19 August 2023	5	1 black man, 4 women (1 coloured woman and 3 black women)

**Table 2:** Results of BBP Workshops

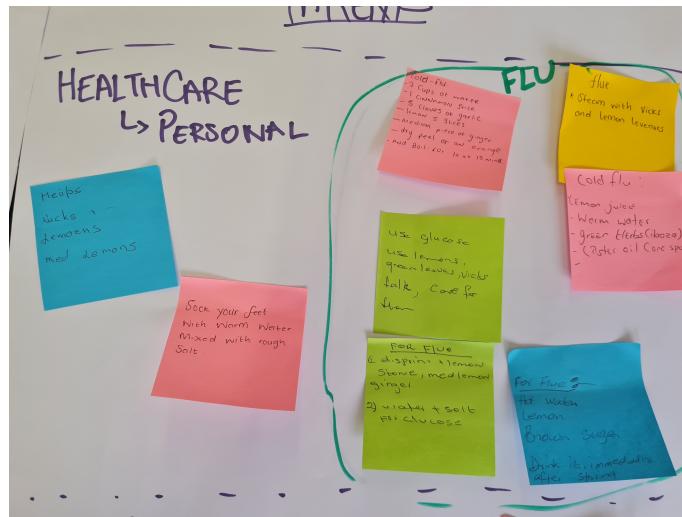
Theme	Code	Quote
Performance Expectancy	Future potential	"can add that as extra content and that actually makes our... enriches our content"
Effort Expectancy	Ease of use	"I think you can, you can find what you're looking for."
Effort Expectancy	Technological limitations	"That is the only problem- to get it on our phones. I think sometimes our phones are old"
Social Influence	Recommending to parents	"I think it will be useful. Like for the first time parents"
Facilitating Conditions	Future	""
Hedonic Motivation	Benefits to use	" The app also teaches us a lot of things"
Habit	Ability to continue using	"kuehwg "
Habit	Need to use	". I've missed Bhabhisana for a few months. It will help a lot."
Frequency	Future	ieghoh
Behavioural Intention	Code	Quote

**Table 3:** Results of Sweetwaters workshops with caregivers

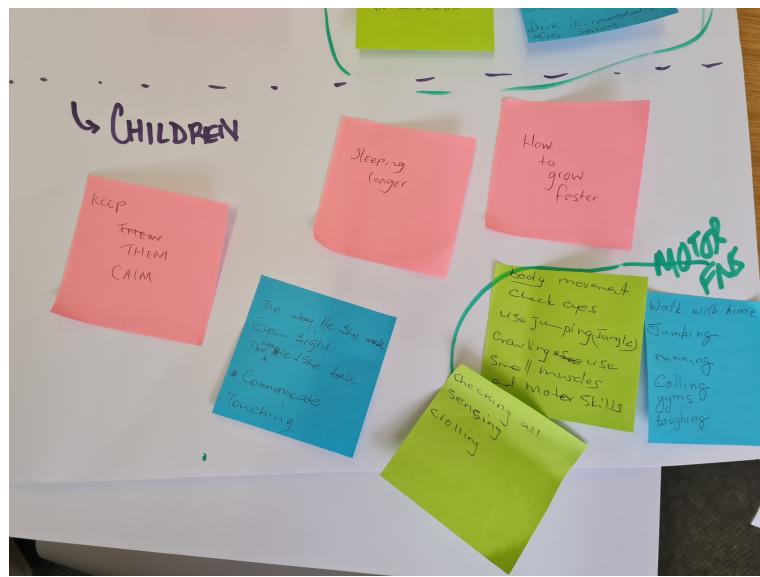
Theme	Code	Quote
Performance Expectancy	Childcare	" it's easy for him to communicate with us when he's happy and he's playing and dancing. "
Performance Expectancy	Childcare	" For very slow parents, it's helpful. "
Effort Expectancy	Ease of Use	P1: "Yes, it is easy [to use]. "
Effort Expectancy	Ease of Use	Oh, for me it was easy.
Social Influence	Content creation	"e have met up and spoke about [creating videos for the app]. "
Facilitating Conditions	Technical issues	"Yeah. I did use it, but not on my phone."
Hedonic Motivation	Benefit	"Because I have kids, I had to use it- mostly the playful ones and the singing ones"
Hedonic Motivation	Motivation	"Because I have kids, I had to use it- mostly the playful ones and the singing ones"
Habit	Use case	P1: "Every time when I'm busy, I use it to get my child to be quiet. Then I give my child my phone, then he opens it."
Frequency	Usage	P1: "I haven't had time [to upload a video] yet, but maybe this week I will"
Behavioural Intention	Motivating factor	P1: "Every time when I'm busy, I use it to get my child to be quiet. Then I give my child my phone, then he opens it."



**Figure 6:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters



**Figure 7:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters- Healthcare



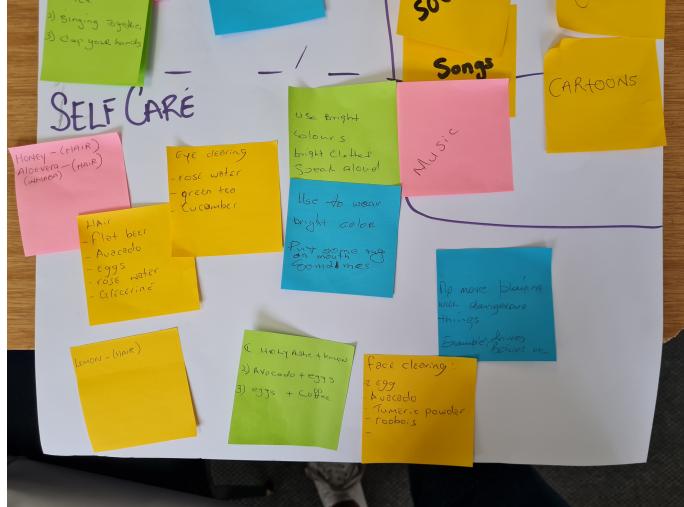
**Figure 8:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters- Children



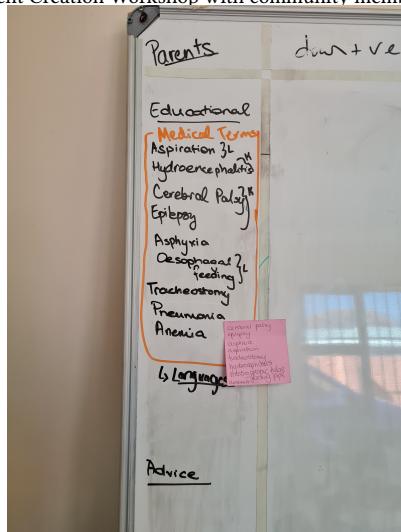
**Figure 9:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters



**Figure 10:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters- Entertainment and Educational videos for parents



**Figure 11:** Results of Co-Design Content Creation Workshop with community members in Sweetwaters- Self care for parents



**Figure 12:** Results of Co-Design Content Creation Workshop with BBP Caretakers