Harnessing technology

A review of digital tools supporting parents and the early childhood workforce

Bernard van Leer FOUNDATION

R4D RESULTS FOR DEVELOPMENT

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Executive summary

Digital tools have become increasingly prevalent in supporting early childhood development (ECD) globally. Accelerated by the COVID-19 pandemic and the closure of childcare facilities and other ECD-focused programs, parents and caregivers have sought alternative ways to support young children's learning and development. The availability and quality of new digital technologies have provided an opportunity to bridge this gap, with the potential to reach a wider audience and improve access and quality of support to young children.

This report offers insight into the current technology-enabled tools designed to support the parents, caregivers, and the early childhood workforce of children ages 0 to 5 worldwide. The report focuses on their features, objectives, and current practices, as well as key success factors, and design, implementation, and dissemination challenges. Drawing from a desk review of peer-reviewed and gray literature and key informant interviews with tool developers and experts, the report also includes four thematic case studies on partnership, adaptation, user engagement, and monitoring and evaluation, and an interactive database showcasing 23 unique digital tools.

A number of key findings emerge from this review, including:
- (1) the necessity of **designing for and with end-users;**
- (2) the power of **leveraging innovative approaches to keep users engaged;**
- (3) the importance of **meeting users where they are with technology;**
- (4) the multiplicity of benefits that can result from **strategic partnerships;**
- (5) the vital **importance of making cultural and linguistic adaptations** when working across heterogeneous contexts;
- (6) the advantage of **building with sustainability in mind** from day one; and
- (7) the upside of **combining digital and in-person interactions** where possible.

In light of these findings, this study offers several recommendations that allow different stakeholder groups to optimize the design, use, and impact of digital tools for parents and the workforce. These recommendations include the following:

- *In order to maximize sustainability and impact of tools,* ***tool developers and program managers*** *should cultivate complementary partnerships and prioritize continuous, purposeful data collection to inform learning and improvement.* Approaches such as formative research or rapid testing can help create tools that end

users regularly use and value. Strategic partnerships, including with other developers, service providers, funders, universities, and governments can not only help support such learning-focused research but also help reduce or share costs, increase the reach of tools, and avoid duplication.

- *By strategically partnering with developers of tools that improve child, caregiver, or parental well being, **governments** can extend their reach.*
- ***Funders** should strengthen the ecosystem for digital tools by providing longer-term, flexible funding and brokering targeted collaborative learning across disciplines.* Longer-term funding with fewer constraints reflect the reality that digital tools may take time to be developed and refined, and to gain traction. Funders are also well-placed to broker knowledge-sharing among those from the public, private, civil society, and academic arenas, which can help seed partnerships and generate new ideas.
- *Given the recent proliferation of digital tools, particularly in low-and-middle income countries (LMICs), **researchers** should prioritize studies on the market size for such tools, the ideal frequency and dosage of programs, effective and equitable user engagement strategies, and innovative financing models. Insights on these topics would substantially advance collective understanding of how to optimize the use and reach of digital tools.*

This study highlights the transformative power of digital tools to provide new modalities for supporting parents and the workforce who support young children. By galvanizing the lessons presented in this report, actors across the ecosystem, including tool developers and early childhood program managers and governments, can improve the reach, scalability, and quality of digital technologies to support parents and the early childhood workforce in promoting the development and well-being of young children across varied contexts.

Introduction

Improvements in the availability and quality of digital technologies have transformed the way in which parents[1] and the early childhood workforce can support young children. Increased mobile phone penetration and connectivity, coupled with the growth of new technologies, have fostered this rapid transformation. For example, in the UK, two parental support apps were released before 2015, whereas around nine new apps were released per year between 2018 and 2020 (Kanders et al., 2022). In particular, the COVID-19 pandemic necessitated that parents take a more active role in their children's development in light of childcare, preschool, and other closures. Coupled with suspension of in-person work responsibilities, this isolation pushed providers to adapt their services to a remote environment (Rubio-Codina & Lopez-Boo, 2022).

In response to the proliferation of new tools, program managers, key technical personnel in governments, donor organizations, and applied researchers are seeking guidance on how to optimize their use. Their interest reflects an understanding of their potential utility, whether by offering complementary options to labor-and resource intensive parenting programs or by equipping parents with easily-accessible, evidence-driven guidance via social media (Kachergis et al., 2020; Kanders et al., 2022). In this context, there is an opportunity to support individuals and organizations to identify those tools which best fits their needs (Early Learning Lab, 2017).

While there is some emerging evidence on the potential effectiveness of these tools including from their use during the COVID-19 pandemic, there are a number of potential benefits which have yet to have been studied. Such potential benefits are wide-ranging, from the ability of tools to enhance the impact of in-person programming, to their capacity to support data-informed decision-making to improve services. Such tools are not, of course, a panacea, as accessibility (including required technology and internet connectivity) and cost can limit their uptake. This study will highlight how tool creators are addressing a number of these challenges, in the process helping others to increase uptake, effectiveness, and scale.

More specifically, this report offers insight into the following questions:

- What types of technology-enabled tools exist to support (a) parents and caregivers of children aged 0 to 5 globally and (b) the ECD workforce?
- What are the key objectives and features of these tools?
- What are the current practices, key success factors, and challenges in the design, implementation, and dissemination of these tools?

This report is also accompanied by [four thematic case studies](#) and an [interactive database of 23 diverse tools](#).

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[1] The term parents is used to encompass the range of caregivers at the household level who support the development of young children.

Methods and limitations

In order to understand existing trends and evidence on the use of digital tools in ECD, as well as to source them for the database, this study leveraged a desk review of peer-reviewed and gray literature. In addition, tools were sourced via an open call through ECD community networks and partners of the Bernard van Leer Foundation. From a longlist of 100+ tools, the team shortlisted 23 tools used across 80+ countries with a specific focus on low-and-middle income countries (LMICs), based on pre-determined inclusion and exclusion criteria (See Box 1). Inclusion criteria prioritized tools currently in use leveraging some form of technology and with strong data availability to support analysis. Tools using traditional media (e.g., radio or TV) as a primary technology component were excluded in order to generate new lessons and experience not previously addressed in earlier research. In addition, tools that arose as a result of temporary pivots due to the COVID-19 pandemic were excluded in order to address questions related to long-term implementation and sustainability. Shortlisted tools reflect diversity across ECD focus areas, geography, and technology used.

Box 1: Tool inclusion and exclusion criteria

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Inclusion Criteria*
- Currently in use
- Uses some form of technology (e.g., app, chatbot, SMS)
- Data availability
- Target population

Exclusion Criteria
- Tools that use traditional media (e.g., radio or TV) as primary technology component
- Tools that pivoted temporarily during the pandemic

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Particular attention was given to tools with a focus on equity (reaching vulnerable populations) and potential for scale. Diversity across tools in ECD focus area across (e.g., nutrition, responsive caregiving, early learning) and geography were considered during shortlisting.

To develop the tool profiles, initial data was gathered from websites, reports, evaluation studies, program design documents, and blog posts and articles, complemented by 21 key informant interviews with tool developers to understand experiences with design and implementation. Additional interviews were conducted with experts (e.g., researchers, investors, senior program leaders) to understand the broader landscape of digital tools for ECD. This report synthesizes findings from the desk review and information across these interviews.

While the research team drew on available data, the study is limited by the lack of robust evidence on the impact of digital tools on early childhood development outcomes, especially from LMICs. The tools reviewed as part of this study reflect only a sample of different types of digital tools - for example, most of the tools in the sample are financed by private foundations and may not be representative of commercially available tools. The study is also limited by its focus on tools targeting parents and the workforce excluding digital technologies directly targeting children in early childhood.

Current ecosystem: Exploring the key features of digital tools for ECD

The following section highlights key trends in the design and dissemination of digital tools, drawing from the literature reviewed, key informant interviews, and an analysis of the 23 tools featured in the database.

Tool focus and functions

Digital solutions have the potential to support all critical areas for ECD as outlined by the nurturing care framework - health (including caregiver well-being and mental health), nutrition, responsive caregiving, safety and security, and early learning - as well as relevant information on developmental milestones. Tools generally focus on at least one and

frequently a combination of focus areas (see figure 1 for distribution of tools in our sample by focus area). Examples of content covered across these focus areas are found in Table 1.

Figure 1: Distribution of 23 tools by focus area

Distribution by focus area

Focus area	Value
Responsive caregiving	20
Health and nutrition	18
Early learning	18
Caregiver well-being and mental health	14
Developmental milestone	12
Safety and security	10
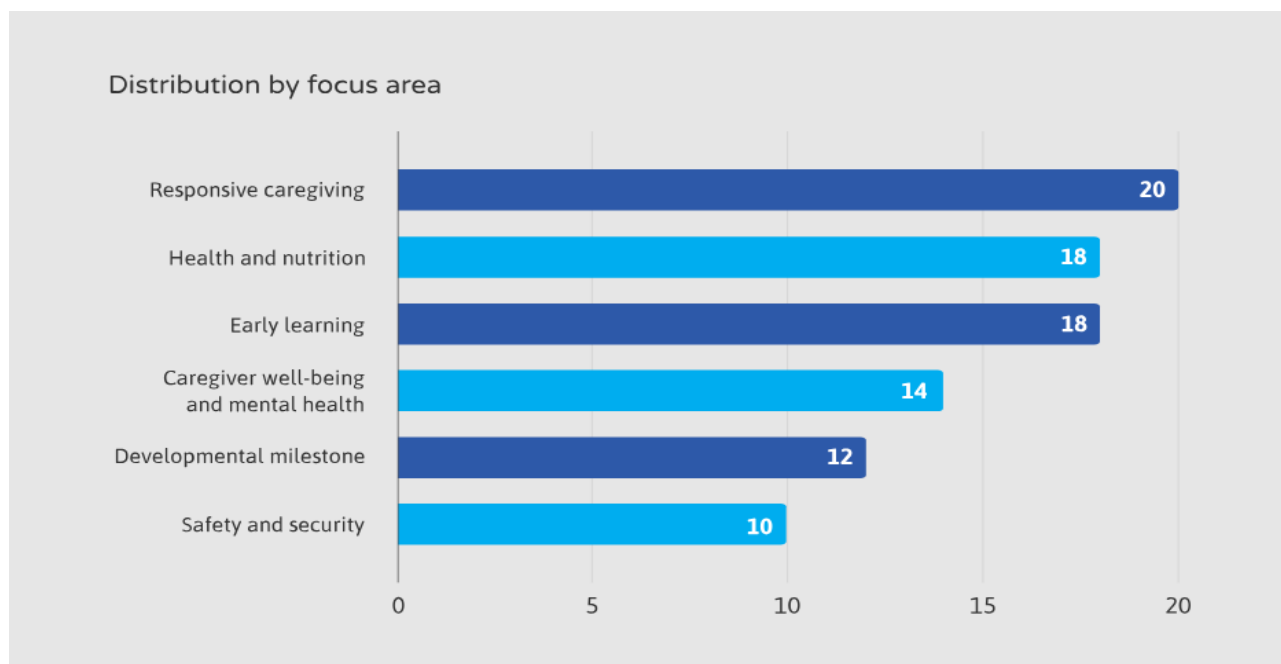
Table 1: Common areas of ECD focus across tools

Focus area	Examples of content covered
Responsive caregiving	• Connecting with the baby • Responding to cues
Health and nutrition	• Immunizations • Height and weight tracking • Breastfeeding and baby-led weaning • Nutrition supplements
Developmental milestones	• Identifying and observing milestones • Tracking milestones
Safety and security	• Positive discipline • Safe home environments • Violence prevention
Caregiver mental health and well-being	• Perinatal depression • Problem solving strategies

| Early learning | • Play based activities |
| | • Pre-literacy and pre-numeracy activities |

These areas were addressed across tools in different ways. Key functions of tools are summarized in Table 2.

Table 2: Key functions of tools

Function	Description	Examples of strategies
Sharing parenting tips and resources (e.g., Pashe Achhi, ParentText)	Sharing knowledge and activities to improve practices, behaviors, and skills in different ways (e.g., short messages, videos) to support child development	• Short messages or modules • Audio recordings • Videos • Articles
Enabling connections across users (e.g., Digitaf, Ready Rosie)	Facilitating connections between different users of the tool including between parents/caregivers, between early childhood personnel and parents/caregivers, and between frontline workers and their supervisors	• Community groups (e.g., on Facebook, WhatsApp) • Discussion forums
Providing expert advice and support (e.g., MomConnect, Baby Buddy App)	Providing access to experts (e.g., nurses, mental health professionals) through various means	• Live chats • 24x7 Helpdesk
Providing referrals to service providers (e.g., SMS4Dads, Winnie)	Directing users towards more specialized support (e.g., mental health professionals, child services) to address needs	• In-built referral pathways • Referral guidelines for ECD personnel
Tracking ECD milestones (e.g., GroeiGids, CDC Milestone Tracker)	Supporting tracking of developmental milestones and immunizations	• Developmental milestones tracker • Vaccinations log • Photo album with key milestones
Supporting program implementation (e.g., Thinking Healthy)	Supporting frontline workers (e.g., community health volunteers (CHVs), home visitors) and supervisors conduct and monitor sessions, and collect relevant program data	• In-built session resources • Tracking session data (e.g., modules completed, duration) • Troubleshooting challenges faced by parent/caregiver by using pre-populated list of challenges and solutions

Training program implementers (e.g., *Jamii ni Afya*, *Jornada Online Primeira Infância* (*JOPI)*)	Providing pre-service, in-service, or refresher training modules to frontline workers and supervisors, and supporting supervision meetings	• In-built training modules • Sharing session data access with supervisor

Target Audience

This study identified 19 tools that target parents and caregivers and 10 tools to support early childhood personnel including home visitors, community health workers, social workers, healthcare workers, supervisors, early childhood care and education personnel, and program administrators. Most tools focus on one group or the other, while some tools provide content both for parents and caregivers as well as for early childhood personnel. For instance, teachers and parents/caregivers access different channels on Sésamo Chatbot, an automated WhatsApp assistant that connects them to a range of free learning resources, to receive content tailored to their needs.

A majority of tools reviewed offer support from pregnancy or birth through age 3 or 5; however, some tools also provide support beyond age 5 (e.g., GroeiGids, ParentText). While existing research and a few informants suggest that female caregivers are more likely to use digital technologies (Zhang & Livingstone, 2019), a few tools have specifically tailored content and strategies to expand reach to male caregivers, for example, Baby Buddy App (see Box 2).

Digital tools frequently offer equitable and personalized support to different users based on need. To this end, a few tools have personalized content for different user groups (e.g., SMS4Dads has developed a set of messages for users from indigenous communities), use visuals, simple language, and audio recorded content to reach low-literacy populations (e.g., Thinking Healthy), and are translated into various languages (e.g., Bebbo). Of the reviewed tools, most developed for LMICs reach users free of charge, do not require the latest software or devices, and have flexible access options to increase penetration within rural areas and low-income communities (e.g., Thrive by Five, ParentText, Mobile Academy).

Box 2: Baby Buddy App

> The Baby Buddy App provides bite-sized information and advice from pregnancy through the first year of baby's life and features contextualized resources for fathers and racial/ethnic minorities. The app content, which was developed for an age-9 reading level, includes a video library to support low-literacy communities. To enable access in communities with limited internet connectivity, app content can be downloaded for offline viewing.

Tool developers have also adopted various strategies to promote user uptake (see Box 3). Commonly used strategies included:

- *Social media campaigns* through static posts and videos, targeted ads, and influencer marketing
- *In-person recruitment* efforts, including through:
  - health clinics, in which trained health care providers share information and encourage sign-ups during health check-ups for pregnant persons or new mothers.
  - on the ground campaigns by field staff or frontline workers who distribute brochures and conduct face-to-face awareness sessions.
- *Advertisements* through radio, television and print media

In some cases, users learned about the tool through search engines or app stores. Partnerships with government entities and local organizations have also supported dissemination and recruitment efforts. For example, *JOPI*, a tool developed to train supervisors of a national early childhood home visiting program in Brazil (*Criança Feliz)*, works closely with state coordinators of the program to increase uptake.
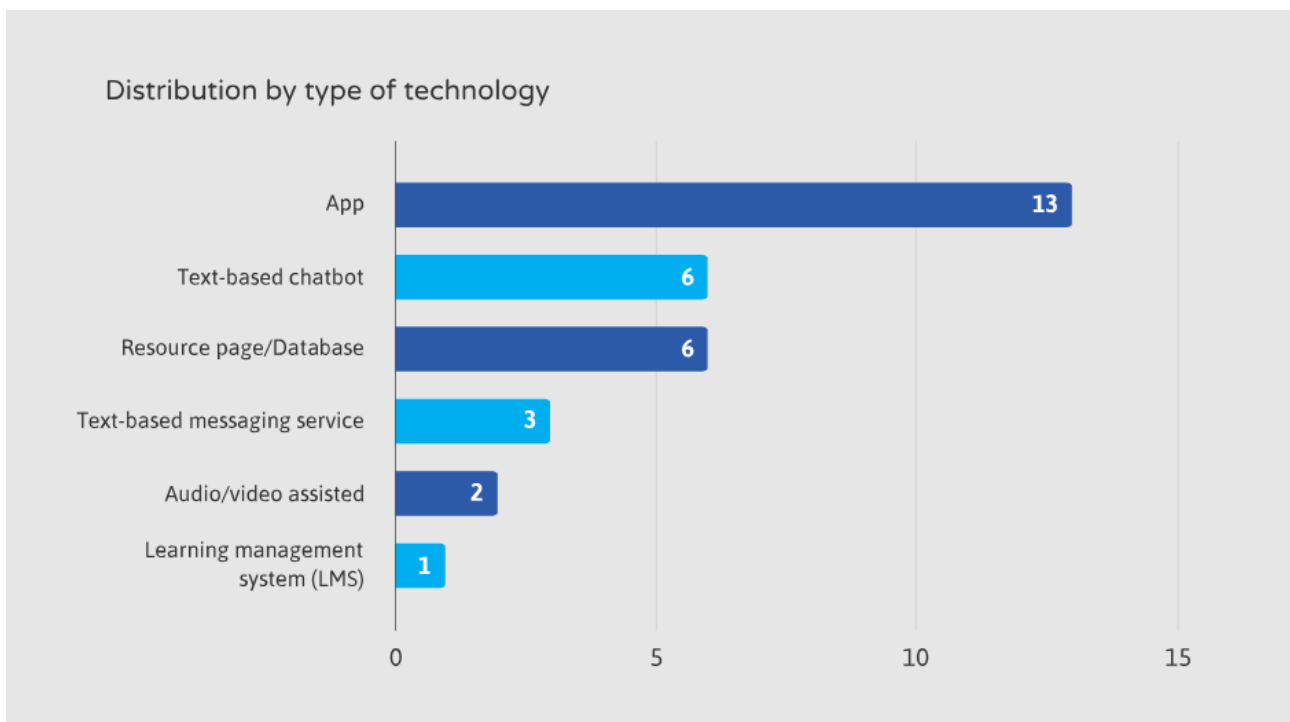
Box 3: SMS4Dads

SMS4Dads leverages social media platforms through targeted ads on Facebook and Instagram, influencer marketing, and planned posts on its own and its partners' social media handles to target fathers and their partners. A dedicated marketing budget supports the creation of radio advertisements to reach fathers in rural areas. In addition, SMS4Dads also partners with health centers, where providers are briefed about the tool and given information

Technology

Six distinct types of digital tools targeted towards parents, caregivers, and the ECD workforce were identified in this study (see Table 3). This included apps, audio/video-based tools, text-based messaging service tools, text-based chatbots (see Box 4), learning management systems, and resource pages or databases (see Figure 2 for the distribution of tools in the sample). While most tools are available only through one of these modalities, a small number of tools are available through multiple modalities to allow flexibility based on users' context and circumstances (e.g., Thrive by Five, MomConnect) and/or host additional features (e.g., in addition to interacting with the chatbot, users of the Parent Education Program can also interact with other users through a community Facebook page and access additional resources through the program's website).

Figure 2: Distribution of 23 tools based on technology utilized

Distribution by type of technology

Type	Value
App	13
Text-based chatbot	6
Resource page/Database	6
Text-based messaging service	3
Audio/video assisted	2
Learning management system (LMS)	1

While tools are available across a range of devices, including phones, tablets, and computers, their connectivity requirements vary. While the audio-based and text-based SMS tools can usually be accessed with cellular service, apps and other text-based tools typically require mobile data or internet connectivity.

To increase accessibility, some tools leverage innovative data use options. Users can access content in different ways (e.g., WhatsApp or SMS), can view it offline once downloaded, and/or select their preferred data use (see Box 5).

Tools can also be used independently by the user or integrated to support or complement existing programs (or both). For example, Digitaf, an online resource page, enables parents to sign up for activities and workshops offered in collaboration with the municipality of Tel Aviv's program to promote child development. Winnie, a tool to identify childcare, preschool, and school age programs, is used by users looking for these services independent of any larger program.

Box 4: Utilizing artificial intelligence to support ECD

With the proliferation of tools utilizing Artificial Intelligence (AI) such as ChatGPT, AI is increasingly seen as a way to meet the needs of diverse audiences. Sheetal Singh, a digital technology expert at Start Early, suggests that "AI powered tools' ability to sort through large data sets can provide more targeted and on-demand content than tools that solely rely on humans to develop and deliver content to a user." For example, Sleuth, a tool that allows parents to share their own experiences and parenting advice with each other, uses AI to classify responses into different themes. Milo, an AI-powered assistant, allows parents to manage various tasks such as grocery lists and upcoming events by organizing and sharing information back with parents as needed.

Within our sample, chatbots such as Afinidata use detailed algorithm flows to determine responses based on user input. Chatbots also bring in an element of interactivity, without the additional cost of hiring staff to communicate with users. In another instance from our sample, Kinedu uses an AI-powered skills assessment which provides personalized activity plans. While the evidence on effectiveness of parenting chatbots is limited, a randomized control trial of a chatbot-based intervention with 170 parents with at least one child between 2-11 years of age in Argentina found that parents were able to learn skills required to promote positive behaviors in their children (Entenberg et al., 2023).

Table 3: Types of digital tools

Category	Description	Examples
Mobile or tablet-based applications (apps)	Tool based on a self-contained and installable program on a mobile or tablet device	CDC Milestone Tracker, Kinedu
Audio/video-based tools	Tools that use audio or video-based technologies such as pre-recorded and scheduled phone calls, telephone counseling, and/or video conferencing software	Pashe Achhi, Mobile Academy
Text-based messaging service tools	Tools that deliver scheduled messages or messages sent by a facilitator through regular messaging services like SMS and WhatsApp	SMS4Dads, *Pé de Infância WhatsApp Journey*
Text-based chatbots	Tools designed using particular algorithms (including AI) which trigger a response based on user input and can be delivered over different messaging platforms like Facebook Messenger, SMS, and WhatsApp	Sésamo Chatbot, Parent Education Program, ParentText
Learning Management Systems	Tools which use software applications to host and manage e-learning courses and programs	*Jornada Online Primeira Infância (JOPI)*
Resource pages or databases	Tools that provide collated resources through an interactive online platform	Winnie, Ready Rosie

Afinidata, an artificial intelligence powered tool used to connect parents and caregivers of children ages 0-6 to a virtual assistant, allows users to access content through Facebook Messenger, Whatsapp or the Afinidata app depending on their preference. Users typically receive weekly activity suggestions and require internet connectivity to access the materials. However, in contexts with limited or low internet connectivity, users can engage with the content when there is connectivity or download materials to use offline.

Data security and privacy

To ensure data security, including personal information such as name, contact details, zip code, and children's details, nearly all tools in the sample had a data protection policy. A few text-based tools also sought user consent to send messages. Data collected for research purposes was generally anonymized. While not observed directly in this sample, there is evidence which notes that apps collecting sensitive data seldom share how the information will be used and that there is a need to ensure privacy statements are easy to read and understand (DeWitt et al., 2022).

Cost model

Most tools in our sample were available free of cost to the user. The majority of such tools, often developed by private foundations, government agencies, and non-profit organizations, are primarily intended to maximize impact. They also do not contain advertisements for products or services. However, tools developed by for-profit organizations may utilize one or a combination of the following models:

- Freemium - The tool is available for free but a user can access advanced features for a fee (e.g., Kinedu)
- Ad-based - The tool is available for free but with advertisements. In such cases, developers earn revenue through advertisers (e.g., Pregnancy+)
- Subscription based - Users receive the service offered by the tool by paying for it periodically, on a monthly, quarterly, or yearly basis (e.g., Winnie for providers)

Partnerships

Tool developers also engaged with various partners to support design, implementation, dissemination, and research (see Box 6). The nature and purpose of such partnerships are diverse, including the following:

- Several multi-country tools engaged with *local non-profits and grassroot organizations* to contextualize content and reach a wider audience.
- *Health care and community centers,* as noted above, have played an important role in dissemination and promoting uptake.
- Tool developers have frequently collaborated with *private technology companie*s to support UI/UX design, tool development, and maintenance.
- Partnerships with *universities, research centers, and academics* have generally focused on routine monitoring and evaluation.
- *Government* partnerships have provided a number of benefits related to funding, approval of tool content, dissemination, and sustainability.

Finally, philanthropic organizations - specifically private foundations and less frequently UN agencies - were primarily funders of these tools.

Funded by Minderoo Foundation, Thrive by Five partners with grassroots NGOs and government entities that support the co-design, validation, and implementation of the tool in specific countries. It also collaborates with the University of Sydney's Brain and Mind Center who serves as the global research partner leading an evaluation of the app, with contributions from in-country partners who support data collection. Other key partners include a global tech partner responsible for the development of the platform and M&C Saatchi which supports the promotion and dissemination of the program across participating countries.

Monitoring and evaluation

Tools converged around a shared set of metrics to monitor progress and analyze user trends. Commonly collected indicators include:
- *User profile* - Enrollment data (including new users and dropouts), user type (e.g., parent, educator), geographic location
- *Tool usage* - Average time spent on tool, response rate (for chatbots), activities/features used frequently, activities/messages liked and shared, module progress, external links accessed. Tools used by early childhood personnel with parents/caregivers may also track data on session duration, attendance, and progress made during the session
- *User feedback* - Feedback on tool design and experience collected through built-in surveys (e.g., rating an activity, questions about using the activity), satisfaction surveys, interviews and focus group discussions, app reviews, and message responses

Data are used for different purposes. User analytics and usage data are frequently pulled into an analytic dashboard that is monitored periodically. Along with user feedback, these dashboards help inform any iterations to the tool. In addition, some tools engage in various forms of research, including feasibility and acceptability studies, process evaluations, tracer studies, and/or impact evaluations (e.g., randomized control trials, pre-and-post assessments). In some cases, tool developers invest in research to explore themes like user engagement and behavior change and test new features (see Case Study on monitoring and evaluation).

While data are used extensively to iterate on various tool features once in operation, they are also used to inform the initial design of tools. Developers use techniques such as focus groups, A/B testing (testing two different features that are randomly assigned to different users), beta testing, usability testing, pilot studies, and soft launches to test a tool with a select group of users before launching to a wider audience.

Key Findings

The following key findings are derived from the literature reviewed, analysis of the sample of digital tools, and key informant interviews with tool developers and experts:

1. Design for and with users

There is a need to build new tools that reflect an understanding of user characteristics, needs and preferences.

Several tool developers noted the challenge of engaging with parents, whose time is often limited due to work and child-rearing responsibilities. To stand out amidst the many messages directed to parents, developers must offer a product that alleviates challenges that parents face and/or address an unmet need. Chian Gong, a venture capitalist with expertise in technology in early childhood at Reach Capital noted that "Parents are a very in-demand audience. It is important to cut through noise to offer something meaningful." For example, SMS4Dads responds to the lack of targeted resources for fathers in Australia whereas the Winnie platform addresses challenges in identifying quality childcare in the U.S. by providing a comprehensive, inclusive, and searchable database of childcare providers, including home-based providers who have not typically been easily identifiable through standard web searches.

Given the breadth of offerings and freely available information on parenting topics, there is, according to those interviewed, a need to truly understand the user and figure out how to make the existing user experience better before launching something new. Carolina Casas, Vice President of Education, International Social Impact at Sesame Workshop noted, "True innovation is not about making something new, but about making something better."

Beyond the scarcity of time that confronts parents, there are many other contextual factors that developers must consider. Ensuring accessibility and relevance of content is also important: many developers who target parents in disadvantaged communities highlighted the importance of written content which caters to low literacy environments. This is also corroborated by a review of mobile apps for child health and development in the U.S., which found that

96% of apps offering explanations of health topics used simple language to explain health terms (DeWitt et al., 2022). Similarly, a feasibility study of Afinidata found that users wanted simple wording and activities (Jaggi et al., 2023).

The tone and reliability of content is also critically important. In Brazil, the developers of the *Pé de Infância* WhatsApp Journey focused on delivering audio/video content in a calm-speaking manner to appeal to parents. A study of hybrid ECD programs noted that a program in Ecuador used images which reflected ethnic diversity to help families identify with the content that it presented (Rubio Codina & Lopez-Boo, 2022).

Many developers reflected on the importance of "bite-sized" content or micro-learning to simplify messaging. Additionally, developers frequently couple written information with various forms of media to increase uptake. For example, Paalan 1000 offers all content in both written and audio form, to ensure usage in rural settings where literacy levels remain low.

Developers must also consider the timing and frequency of outreach. Research on text messaging programs targeting parents in the U.S. highlight challenges related to frequency of outreach. A study of a program to improve parenting practices for parents of 4 year-olds found that one text per week was less effective than a set of three texts, but that five texts per week was not beneficial to children and contributed to program drop out (Cortes et al., 2018). In addition, a review of eight text messaging programs targeting parents to support school readiness in the U.S. also found that programs sending five texts per week had higher drop out rates compared to those sharing three messages per week, and those sending three texts per week had a higher dropout rate compared to those sending one per week (Fricke et al, 2018). While these examples reflect some emerging evidence on this topic, there is a need for further research to better understand ideal timing and frequency of outreach across digital tools.

A number of developers also highlighted the importance of both conducting formative research and regularly collecting user feedback to ensure relevance of content and usability of tools. Performing early user testing was noted as a success factor, as was collecting feedback over the course of implementation. For example, an app in *Jamii ni Afya* which provides support to community health volunteers (CHVs) in Zanzibar, has been engaged in Plan-Do-Study-Act cycles to understand how best to increase community health volunteers' ability to engage with fathers. Baby Buddy App, a UK-focused parenting app, utilizes a 300+ parent panel to collect insights on upcoming features through surveys, focus groups, and individual calls.

2. Meet users where they are with technology

Technology must be accessible and familiar to users.

Rather than attempting to migrate parents and early childhood personnel to new platforms, evidence suggests that developers should instead leverage existing and proven technologies. For example, for parents who have only basic mobile phones with no internet access, text messaging may be an effective means of reaching them (Dinarte Diaz, 2023). For similar reasons, the *Pé de Infância* WhatsApp Journey, based in Brazil, decided to use WhatsApp because of the high rates of usage and familiarity with the platform. In another example, one developer noted the importance of using 'low-tech' (i.e. phone calls) options in a humanitarian context in Bangladesh, where other options may have been unfeasible. Providing a menu of options for using tools may also help to expand reach based on what is preferred and most accessible to users. For example, Digitaf, allows parents to view activities being offered either on the app, website, Facebook group, or through SMS notifications.

Regardless of the type of technology selected, users may need additional technical support. A feasibility study of Afinidata found that mothers in remote areas benefit from assistance with installation and initial exploration, along with a physical booklet with instructions after the initial period (Jaggi et al., 2023). For similar reasons, once a new user is recruited to MomConnect, a WhatsApp-based chatbot in South Africa, they are provided with an onboarding over WhatsApp, with detailed information on how to navigate the platform. A study of ParentApp for Teens, a digital parenting program for parents of teens across several African countries found that users faced challenges with downloading and opening the app which contributed to high drop-out rates (Awah et al., 2022). Thus, unsurprisingly, developers spoke about the importance of a user-friendly interface; one developer noted "when there are multiple steps, you will lose the user."

Connectivity challenges are widespread and can dampen usage for many of these tools. User testing of ParentApp for Teens found that participants anticipated barriers to use due to data costs for downloading the app, as well as the lack

of android smartphones, and limited technological knowledge (Awah et al., 2022). These challenges tend to be more acute in rural settings, with one developer noting that in such areas, users tend to download content received every few weeks and review it offline, whereas in urban areas there is more frequent usage of material online. One tool developer acknowledged that their app cannot be used in low-bandwidth environments because it requires regular software updates. To address such needs, some apps, like Thrive by Five, once downloaded, can be fully accessed offline. The developers have also successfully tested and proven the app to work on older devices which do not require the latest software.

Access to devices may also pose a challenge. For example, developers noted that in some households, there may only be one device used by a male head of household making it difficult for others to use it regularly. Accordingly, there is some research which suggests that women's mobile phone ownership is important for delivering digital health programs (LeFevre et.al., 2020). With the *Jamii ni Afya* digital platform, the program provides smartphones and a connection package to all community health volunteers so that they may access an app that helps them to carry out their home visits with families.

In addition, some users may not have sufficient data storage on their device. To address this challenge in particular, the Paalan 1000 parenting app in India provides external links to videos instead of embedding them within the app itself. ParentText further mitigates this issue by allowing parents to choose their preferred level of data use - basic, medium, or high - which determines if they will receive only text-based messages or both text-based and multimedia messages (e.g., images, GIFs, videos).

3. Keep users engaged through different approaches

Developers use a variety of approaches to sustain user interest and engagement.

Maintaining interest in use of digital tools can be challenging, as there are often high attrition rates (Jaggi et al., 2023). Sheetal Singh, a digital technology expert at Start Early, commented that "with any digital solution, there is a cognitive burnout…You may be interested earlier on, and then at some point, you lose interest. Keeping users engaged is really hard." A common strategy developers use for engaging users is to customize content, whether by user and/or age, gender, and stage of development of a child. For example, Kinedu, a parenting app, utilizes an AI-powered child milestone tracker to feed into personalized plans with play activity and video recommendations. The Baby Buddy App also offers differentiated pathways based on the profile of a parent/caregiver. Users can select a pathway - mothers, fathers, and healthcare professionals (further updates to the app will include pathways for LGBTQ+, adoptive parents, and surrogates) - which customize content.

Nudges and reminders are also commonly utilized to promote sustained use. For example, an app supporting community health volunteers (CHV) under the *Jamii ni Afya* digital platform in Zanzibar reminds CHVs when to make follow-up visits to families based on identified needs. Thrive by Five sends users simple nudges and reminders to try activities from the app. These messages can also boost engagement. The Parent Education Program sent push messages to nudge users to complete weekly modules; however, when this functionality was paused due to restrictions in the technology platform, they observed a 20% decrease in the number of users who completed the modules.

Another commonly used approach to motivate tool usage is to incorporate elements of gaming (or gamification), which can take different forms. For example, in the mobile app Paalan 1000, completion of certain milestones prompts a celebration with confetti, whereas with the Thinking Healthy app, mothers can set a health-related goal (e.g., diet, relaxation exercises) and track its progress through a 'progress tree' that flowers when a goal is achieved. Other approaches include interactive quizzes and progress trackers, both of which are leveraged in ParentText (see Case Study on user engagement).

Network sharing, encouraging users to share specific content from a tool with others or to invite family/friends to share in a particular tool experience, can generate interest from users. Pregnancy+ and Baby+, pregnancy and parenting support apps, offer options for users to invite friends and family to download the apps and link to their account to follow stage- based updates. The Bebbo app allows users to save and share their favorite content with others.

Other programs have made creative use of incentives. For example, Mobile Academy, which provides training to ASHA workers in India, offers a formal certificate from the NHM and Government of India with a logo, which motivates users

to use the tool and complete the training. Tools may also mix fun and entertaining content to increase user engagement. One program mentioned that interactive features such as uploading baby pictures helps its parenting app to retain users.

While a number of approaches are in use, further research on the effectiveness of different user engagement and behavioral change strategies is needed (see Box 7).

Box 7: Common user engagement strategies

- *Customized messages:* Sharing resources and content based on user needs (e.g., race/ethnicity, gender, age of child). This also includes sharing personalized content based on short user assessments (e.g., activities shared based on child development assessments).
- *Flexible tool experience:* Providing flexibility and choice for users to determine their use of the tool (e.g., frequency of messages, content, sequence)
- *Gamification:* Using common gaming design elements (e.g., points, badges, trophies, leaderboard)
- *Interactive quizzes:* Short questions (usually multiple choice) or polls provided to users after completing an activity or module to check their understanding
- *Nudges and reminders:* Sharing messages to encourage users to take particular actions (e.g., appointment reminders, nudge to complete an activity)
- *Goal setting:* Allowing users to choose their goals for a particular theme, usually from a list of pre-populated goals
- *User progress tracking:* Tracking user's progression across tool features (e.g., number of activities completed, progress towards goals)
- *Network sharing:* Encouraging use of the tool simultaneously with a partner/alternate caregiver to create a shared experience or sharing tool resources and content with others through messages or social media

4. Combine digital tools with in-person support

In-person support and programming helps promote uptake and relevance of digital tools.

Recent research on hybrid programs (combining in-person and virtual elements) found that a minimum level of in-person interaction increases families' buy-in and commitment (Rubio-Codina & Lopez-Boo, 2022). Similarly, an evaluation of a text message-based parenting intervention in Uruguay found that while messages alone had minimal impact on parenting knowledge or behaviors, child-rearing environments or family wellbeing, when paired with in-person interaction their impact increased (Balsa et al., 2022b).

Consistent with this evidence, a number of tools feature elements of in-person support, which they view to be critical for establishing relationships with families, facilitating trust, and increasing uptake. Interviewees frequently noted that community connections and trusted providers helped tools to reach their target audience. For example, MomConnect utilizes focal points in each province where it operates to ensure clinics know about the service. Similarly, Paalan 1000, a mobile parenting app in India, leverages frontline workers for recruitment and promotion since they already have touch points with target families. The CDC Milestone Tracker app is promoted by 'Act Early Ambassadors' who work with their respective states to expand the reach of CDC's 'Learn the Signs. Act Early' program.

Where in-person support is not fully available, some form of human interaction (even virtual) may mitigate this challenge. One developer noted how, by facilitating WhatsApp groups, they have expanded user engagement.

While not the main focus of this review, adding remote support to ongoing in-person services may also be beneficial. A study in Jamaica of a home visiting program which pivoted during COVID-19 found that addition of remote support made caregivers feel that facilitators were interested in their children's outcomes (Rubio-Codina & Lopez-Boo, 2022).

5. Invest in a complementary set of partnerships

Partnerships can reduce costs and bolster technical expertise, help to avoid duplication, and increase scalability and sustainability.

Our research highlighted the range of potential benefits of partnerships. Partners bring in expertise to help generate tool content, support development and maintenance of tool technology, and contribute to research and evaluation support (Early Learning Lab, 2017).

Baby Buddy App's partnership approach highlights how collaborators can augment their impact. For instance, UK's National Health Service accredits messages shared through the app, lending credibility to the tool. Baby Buddy App also utilizes a panel of experts drawing from Royal Colleges of Medicine to validate the content. Similarly, Descobrir Brincando, the developer of *JOPI*, has judiciously cultivated partnerships, including with a local university (Faculdade Getulio Vargas, São Paulo) to conduct a randomized control trial to assess the impact of the tool-provided training on supervisors' behaviors.

Partners may also help promote uptake of tools, as partnerships with local grassroots and non-profit organizations, health centers, preschools, and frontline workers have been leveraged to reach and recruit users. For example, SMS4Dads partners with National Rural Health Alliance and Indigenous HealthInfoNet to expand their support to fathers in rural and remote areas, as well as Aboriginal and Torres Strait Islander men. It also collaborates with health centers where providers are briefed about the tool and given informative pamphlets to support recruitment of fathers. Ready Rosie, a web-based platform that connects schools and families with children ages 0-9 in the U.S., relies on partnerships with public schools and NGOs to deliver parenting curriculum in the form of videos and workshops to caregivers, facilitate communications between families and teachers, and provides online and/or live professional learning to teachers.

Establishing partnerships can also help new initiatives build on existing efforts rather than starting from scratch, thereby saving time and resources and avoiding duplication. This was a particularly common practice in developing tool content. For example, the Parent Education Program partnered with the East London Research School to adapt their "What to expect in the Early Years Foundation Stage: a guide for parents" curriculum. They also translated messages from Vroom, a well-known parenting app developed by the Bezos Family Foundation, to create short videos in Arabic to share with parents. Vroom messages have also been adapted for use in other tools like Paalan 1000 and Bright Tomorrows.

In addition to providing technical expertise, government partners are also critical to support scaling and sustainability efforts. Developers have commonly leveraged existing government infrastructure (e.g., public health clinics, network of frontline workers) to spread awareness and reach more users. For example, all frontline workers receive immediate access to Mobile Academy in India, a phone-based refresher training, once they register on the Government's Reproductive and Child Health portal. Government agencies can also support funding and implementation efforts. The Ministry of Health worked closely with D-Tree to test different versions of the *Jamii ni Afya* app and supported adaptations, where necessary, to better meet the needs of families (see Case Study on partnerships).

While government partnership can provide a range of benefits, they are not without risk. Of note, changing government leadership can disrupt established relationships with outside organizations. To mitigate this risk, MomConnect has a dedicated person responsible for the tool in the National Department of Health, which has helped sustain it for nearly 10 years.

6. Adapt tools to each cultural and linguistic context

Adapting tool content can ensure relevance across different contexts.

Developers emphasized the importance of considering and reflecting users' cultural contexts, especially when implementing a tool in a new country. Recognizing that "one size does not fit all", developers used processes like human- centered design and anthropological research to adapt their tools to different contexts. This included ensuring that tool content is reflective of local culture, values, and practices; illustrations, photos, and videos are representative of users; and content is translated to local languages. For example, Pregnancy+ does not include

content on buying clothes for babies before birth across all countries since this is not appropriate in some cultures. Thinking Healthy, a maternal depression support intervention in Pakistan, has an illustrated 'avatar therapist' in the app which resembles features and clothing of women in the country. Paalan 1000 adapted Vroom messages by including contextualized examples such as "luka-chuppi" (hide-and-seek) instead of "peek-a-boo" and "local bazaar" (market) instead of supermarket.

The adaptation process usually involves a range of stakeholders, including local subject matter experts, parents and caregivers, curriculum specialists, and in-country partners such as grassroot non-profits and government agencies who help identify and incorporate local needs, practices, and examples and test the tool content. For example, the Thrive by Five program's adaptation process involves a series of workshops with local stakeholders to ensure that local parenting practices are reflected in the content. User testing of Vroom, a parenting app first developed for the U.S., in Syrian refugee contexts, found that parents responded better to messages which were framed as supporting brain development rather than those that were intended to be fun (Wilton et al., 20187) (see Case Study on adaptation).

Adapting tools to different contexts was recognized as a key success factor to benefit parents (Early Learning Lab, 2017). As one developer noted, "the more you [the user] feel it is made for you, the more you enjoy the experience." However, while beneficial, this process can also be time intensive and costly. One developer reported taking an entire year to translate and contextualize content including re-making videos in a different context. Another cited that while the translation process is easier, adaptation can be difficult as it requires carefully considering all of the content and ensuring appropriateness. To address the high cost of adapting a tool to a specific country, one expert recommended avoiding the use of words that are specific to a particular country and instead using common activities and examples, and providing neutral recommendations. This would ensure, for example, that an app in Spanish could be beneficial across different Spanish-speaking countries, where there are significant cultural variations.

7. Design for sustainability

Sustainability of tools is challenging given the ongoing costs required for maintenance and updates.

The high cost of developing and maintaining the infrastructure for digital tools was noted by several developers as a barrier to sustainability. Ongoing investments are required not only to build tools but also to maintain (e.g., fix bugs), scale, and upgrade them (e.g., adding new features, new content). For instance, in response to updated guidance on developmental milestones from the Centers for Disease Control (CDC), the Kinedu app had to change its content, which required new work and costs. Costs may also change across the tool's lifecycle. A program in Brazil, *JOPI*, which initially started on WhatsApp, transitioned to a LMS accessible by computer partly due to a change in WhatsApp policies which led to increased costs to the user.

Cristina Gutierrez de Piñeres, a pioneer and proponent of the use of digital technologies at United Way Colombia, highlighted a misconception that technology can "run itself" when in fact, there are ongoing, hidden costs associated with the training of users and facilitators, implementation itself, and monitoring and evaluation, which is indispensable for tracking the effects of digital tools. For example, Pashe Achhi, a telecommunication-based tool that provides psychosocial and parenting support, had to train facilitators on the script and communication skills to deliver the program content. As noted earlier, costs are also incurred in adapting tools to different contexts to support translation and development of contextualized resources and content.

Developers and experts also highlighted the need to be agile and responsive to changing landscapes. In addition to having to integrate user feedback and latest evidence in child development in the tool content to remain relevant, developers also need to be aware of and integrate rapidly changing technology features (e.g., new softwares, compatibility with new devices). Recognizing the need to "be thoughtful and deliberate in learning", the developers of Sésamo Chatbot set up an internal working group with members working with technology (e.g., distance learning programs, integrating technology in programs) to discuss challenges, brainstorm solutions, and determine how to integrate their learnings in the tool.

While iterating tools is critical for their relevance and sustainability, developers expressed concerns in raising the funds to support these upgrades. Funders usually require a clear proposal and results to grant funding; however, this is difficult to provide until a tool has been rolled out and produced demonstrable results. One developer also highlighted the challenge of piecing together resources from different funders with varied interests under one overarching vision. Relying solely on external funding from private foundations and government agencies could also be a risk to sustainability when their funds dissipate. Similarly, if user fees are the only source of revenue for a for-

profit developed tool, it competes with freely available resources and lower-income populations may be excluded. Examples of tools that are launched but eventually cease operations owing to lack of funding abound.

To overcome these challenges, developers and experts recommend generating buy-in and support from the government to champion the initiative, and cultivating collaborations and partnerships to reduce or share costs. Developers also suggest exploring creative pathways for lowering costs. For example, MomConnect started offering content over WhatsApp to circumvent the high telecommunication costs incurred through SMS. ParentText offers SMS as an option only in countries where they have partnerships with telecommunication companies, as universal provision of this feature is too costly. In the case of *Jamii Ni Afya*, D-Tree has developed a long-term transition plan for shifting technical and financial responsibility of running the platform to the government in support of sustainability (see Case Study on partnerships).

Recommendations

Tool Developers and Program Managers

- **In order to maximize sustainability and impact of tools, tool developers and program managers should cultivate complementary partnerships and prioritize continuous, purposeful data collection to inform learning and improvement.** The use of data to inform tool decision-making should begin at the design phase, with formative research to identify and address user needs. Tool developers and program managers should then continuously monitor and collect feedback, including testing different approaches for reaching and engaging end users. Efforts to evaluate and improve the effectiveness of engagement strategies can be augmented by partners, including universities, who may have technical expertise in applied research. More broadly, partnerships with others, including service providers, funders and government should be prioritized to reduce or share costs, increase the reach of tools, and avoid duplication.

Governments

- **By strategically partnering with developers of tools that improve child, caregiver, or parental well being, governments can extend their reach.** This requires that governmental leaders provide an enabling environment for such tools to flourish, including providing adequate support to teams to adapt and improve tools, investing in physical and human infrastructure, leveraging the breadth of their communication apparatus, and judiciously integrating tools into existing government programs.

Funders

- **Funders should strengthen the ecosystem for digital tools by providing longer-term, flexible funding and brokering targeted collaborative learning across disciplines.** Longer-term funding with fewer constraints reflect the reality that digital tools may take time to be developed and refined and to gain traction. Shorter-term funding reduces experimentation and iteration. Moreover, funders, especially those that work across multiple constituencies and partners, are well situated to broker knowledge sharing among those from the public, private, civil society, and academic arenas. By facilitating exchanges among those groups, funders can support a cross-pollination of ideas, reduce duplication, and seed innovative partnerships.

Researchers

- **Given the recent proliferation of digital tools, new research, particularly in LMICs, on the market size for such tools, the ideal frequency and dosage of programs, integration of in-person support, effective and equitable user engagement strategies, and innovative financing models would substantially advance collective understanding of how to optimize their use and reach**. This study also revealed that there are few digital tools targeting early childhood personnel despite the potential to expand the reach of training and professional opportunities. Additional research would help advance efforts to better reach this target audience.

Annex: Case studies

Case Study 1. Partnering with governments to expand reach and impact

Collaborations between private organizations and governments have helped expand the reach and impact of tools with parents and caregivers. For example, a partnership with the Ministry of Health in Zanzibar through the *Jamii ni Afya* ("community is health" in Swahili) National Community Health Program, has helped community health volunteers across all 11 districts to strengthen their interactions with families. In India, a partnership has leveraged government systems to roll out Mobile Academy, the largest mobile learning platform for frontline health workers. Embedding data from digital tools into government information systems has also promoted data-informed decision making.

Jamii ni Afya (Zanzibar)

Jamii ni Afya is a national community health program which provides home visits by community health volunteers (CHVs) to mothers and their children under age five in Zanzibar. The Ministry of Health, D-Tree – a global health organization with experience integrating digital tools to strengthen health systems – and Medic have collaborated to develop and deploy a digital platform to support CHVs and their supervisors at scale. Each CHV receives a smartphone loaded with an application that provides guidance to a CHV in their interactions with families. A second app associated with the program guides supervisors in carrying out routine observations of CHVs during home visits. Both the CHV and CHV supervisor applications have been created through the Community Health Toolkit which is an open source tool for creating health apps.

By August 2021, the Ministry of Health and D-Tree had scaled the app from an initial pilot to a national program that works with about 2,300 CHVs and reaches more than 1.4 million people across all 11 districts in Zanzibar. A key to success has been the strong partnership between the Ministry of Health and D-Tree, which dates back to 2010. To support this success, secondment exchanges between D-Tree and MOH staff have been a core component to transferring skills and expertise in aspects of program implementation management, technology and data use. Notable accomplishments include the revision of the National Community Health Strategy which is very much aligned to the first Zanzibar Digital Health Strategy, an approved national curriculum for CHV service delivery, trained national trainers and various iterations of the app which incorporate feedback from users and clients to better meet the needs of families.

Data use is becoming an increasingly important part of the program and the teams are working on integrating the community-level monitoring data from the app into the government health information system (DHIS2), thus promoting data-informed decision making at the national and district level. The integration of the two systems will enable *Jamii ni Afya* to provide population-level data on community health service delivery and information on early childhood risks, outcomes, and programme impact that can be used to inform advocacy and programming.

Now that *Jamii ni Afya* is operating at full national scale, the Government of Zanzibar has committed to full financial, programmatic and technology ownership of the program over the next four years (2023-2026). The *Jamii ni Afya* transition plan was signed in April 2023, detailing the gradual transfer of the program to the MoH. In the first year of the transition, the MOH has committed to include 25% of the *Jamii ni Afya* annual operations cost in the national 2023-2024 health budget.

Mobile Academy and Kilkari (India)

In India, the Ministry of Health and Family Welfare (MoHFW) has collaborated closely with ARMMAN – a non-profit focused on mHealth – since 2019 to implement two complementary digital tools to support mothers with young children at scale: Mobile Academy and Kilkari. By working within government systems, the partnership has achieved impressive reach.

Mobile Academy is the largest mobile-based training program for frontline health care workers employed by the government known as Accredited Social Health Activists (ASHA). These ASHA workers focus on mobilizing

communities and facilitate access to health services in rural areas. The Mobile Academy tool addresses the lack of ongoing professional development available to these community health workers. Specifically, Mobile Academy consists of pre-recorded modules – ASHA workers dial in to listen to them – designed to promote the knowledge of preventative health behaviors and improve quality of engagement of ASHAs with pregnant and new parents, and their families.

Leveraging government systems has been key to reaching so many health workers. All ASHAs receive immediate access to Mobile Academy once they are registered on the Government's Reproductive Child Health (RCH) portal. More than 300,000 users across 17 states in India have started the course, and about 75% complete it, a high completion rate for mobile training. One success factor of the tool is how it incentivizes ASHAs to complete the training. Once the ASHA completes all chapters and quizzes, they will get a final score. If this score exceeds a certain threshold, they receive a certificate from the Ministry of Health. This official government recognition has been found to be a motivating factor for an often-undervalued workforce.

The second, complementary tool is Kilkari, the largest maternal messaging program in the world. Kilkari has reached over 33 million mothers (3.2 million current users). Kilkari targets pregnant and new parents by sharing tips and resources directly to their phones. When a pregnant person is enrolled in the RCH portal by frontline health workers, they receive access to government services including Kilkari. Through this RCH portal, Kilkari and Mobile Academy have been scaled up to cover most states in India.

As a public-private partnership, the government supports telecom costs, while ARMMAN manages the program implementation, building off their previous experience with mHealth tools. The MoHFW also provides inputs on program improvement measures and approves program material (e.g., translation of training content). In the coming years, the MoHFW and ARMMAN plan to expand the reach of Mobile Academy across all 29 states and 7 union territories in India. ARMMAN is also planning to launch more targeted and nuanced multimedia content (e.g., videos, images) to complement the existing audio content.

Sources:
C.Madunda, personal communication, January 23, 2023

C.Madunda & G. Besana, personal communication, February 1, 2023

K.Dalal & J.Balakrishnan, personal communication, December 19, 2022

Wilson, K., Nelson, A., Craig, T., Hofmann, R., & Layer, L. (2020, Nov 5). *Jamii ni Afya: using digital tools to scale integrated services to mothers and children in Zanzibar.* Early Childhood Matters. https://earlychildhoodmatters.online/2020/jamii-ni-afya-using-digital-tools-to-scale-integrated-services-to-mothers-and-children-in-zanzibar/#author-allyson-nelson

Case Study 2: Adaptation of tools to ensure cultural relevance

The adaptation of digital tools to new populations and geographies requires a deep understanding of the cultures and traditions of the main target audiences. A tool that has success in one context does not guarantee success in another. Research, testing with parents, and communications strategies help maximize relevance and impact in new settings. To adapt Thrive by Five to 10 different countries, the University of Sydney's Brain and Mind Centre has led an intensive co-design process with local partners to localize, translate, and disseminate the program. The International Rescue Committee has adapted the Vroom parenting program from the US to reach Syrian refugee families in Jordan and Lebanon by translating messages, adapting illustrations, and testing different delivery platforms

Thrive by Five (Asia and Sub-Saharan Africa)

Thrive by Five combines parenting research with more than 100 caregiver-child activities that reflect local contexts. The activities are organized around five key domains: (1) Connect, (2) Talk, (3) Play, (4) Healthy Home, and (5) Community. Through a structured adaptation process, Thrive by Five aims to uplift local parenting practices and to disseminate evidence-based resources that reflect diverse cultures, traditions, and practices. The program and app are currently available in 10 countries across Africa and Asia.

The Brain and Mind Centre, with support from the Minderoo Foundation, leads the co-design process in adapting Thrive by Five. Prior to launching in a new country, the team identifies in-country partners (NGOs and government representatives), who use their local knowledge and connections to help with localization, translation, and dissemination of Thrive by Five. The co-design process is guided by anthropological research and extensive feedback from local parents, caregivers, and child development experts to ensure that the language, illustrations, and local examples referenced in the activities are tailored and relevant to the country context. The team also helps in-country partners to explore ways to embed the content into existing programs and delivery platforms.

In Afghanistan, for example, the Brain and Mind Centre, Minderoo, and partners developed preliminary content for the app based on anthropological literature, a search for local examples, and contributions from local subject matter experts. Local users then tested out the app features, functions, and content. The adaptation process included a series of 8 co-design workshops conducted in 2021 and 2022 to explore:
- cultural appropriateness and relevance
- desired attributes, skills and values for children
- gaps in knowledge of ECD and nurturing care
- essential caregivers for a young child
- app 'look and feel'; usability and acceptability
- barriers to uptake and adoption of the app
- alternate modes of content delivery (e.g., radio, television, text message)

The workshops revealed several observations which led to changes to the app. For example, participants raised safety concerns about children playing outside in Afghanistan. In response, activities which included only outdoor activities were modified to include an indoor alternative (e.g., climbing stairs or objects in the home instead of trees). Participants also discussed the need for other caregivers to engage more with children as many mothers carry the time-intensive responsibilities of managing household tasks and caring for children and extended family members. The app was revised to explicitly encourage fathers, older siblings, and extended family to take part in activities (e.g., reading, playing games).

Thrive by Five also has been adapted to reach communities with low awareness of the importance of ECD or limited access to this information. To respond to diverse needs and contexts, including low-literacy caregivers and more remote communities, the program can also be delivered using different platforms, including: health services, print media, radio, television, and WhatsApp. Content is available through a WhatsApp chatbot in Cameroon, Namibia, Kyrgyzstan, and the Democratic Republic of Congo. Community Health Workers in Namibia and "educarers" in Indonesia have also used the program.

Vroom (Jordan and Lebanon)

Vroom is an app that encourages busy caregivers of young children to turn existing routines, such as meal time and bath time, into "brain-building moments." Originally designed for low-income parents in the United States, the International Rescue Committee (IRC) adapted Vroom tips and delivery channels for Syrian refugees in Jordan and Lebanon. Guided by human-centered design and behavioral science, the team sought to better understand the most compelling and culturally-relevant content, mediums, delivery channels, and framing of messages for displaced parents. The goal was to expand the reach and impact of IRC's programs, building on the strengths, knowledge, and skills of the parents they serve.

As part of a five-month adaptation process, the IRC team sought to answer:
- What type of messaging is most appealing and motivating for Syrian parents?
- Which delivery channels feel most comfortable and accessible for Syrian families?
- Do different delivery channels lead to different types of engagement with content?

The IRC translated Vroom tips into Arabic and field-tested different versions of the messages with Syrian refugees in Jordan and Lebanon to help capture how parents naturally speak. The team refined and simplified the language so that the messages are accessible to parents with diverse levels of literacy. In addition, child development experts from the Middle East reviewed and provided technical feedback on the content. The videos developed from these adapted messages were tested through in-home interviews, as well as a text message campaign and survey. The team also used A/B testing of strategies to reach families over Facebook, WhatsApp, and an offline-compatible app with embedded videos to gauge which of the three delivery channels was the most accessible and engaging.

The results of this adaptation process led to localized Vroom tips, in an accessible version of Arabic, that were based on what parents already do with their children. The testing found that familiar platforms (Facebook, WhatsApp) can be used to recruit users and disseminate simple, engaging videos that encourage parent behavioral change. In particular, Syrian parents responded better to messages framed as activities impacting brain development compared to those framed as enjoyable or fun. The researchers found that users prefer video (animated or live-action) over text and that caregivers use apps (other than WhatsApp) less than expected. Television was identified as another potential channel because it has extensive reach with caregivers. The study also found that Vroom messages could be integrated into group parenting programs and home visits for more vulnerable and isolated families. The team is currently piloting ideas that emerged from the prototyping on a larger scale in the two countries.

Sources:
C. Nielsen and S.Schofield, personal communication, January 24, 2023

Minderoo Foundation. (2022, Nov 25). *Co-Design Is Key: A New Scientific Report Details Thrive By Five International's Unique Localisation Approach.* https://www.minderoo.org/thrive-by-five-international-program/news/co-design-is-key-a-new-scientific-report-details-thrive-by-five-internationals-unique-localisation-approach/

LaMonica, H. M., Crouse, J. J., Song, Y. J., Alam, M., Ekambareshwar, M., Loblay, V., Yoon, A., Cha, G., Wilson, C., Sweeney-Nash, M., Foo, N., Teo, M., Perhirin, M., Troy, J., & Hickie, I. B. (2022). Developing a parenting app to support young children's socioemotional and cognitive development in culturally diverse low- and middle-income countries: Protocol for a co-design study. *JMIR Research Protocols*, *11*(10). https://doi.org/10.2196/39225

Weatherill, J., Pragita, M., Wat, A., Taneja, A. (2022, June 23). Elevating Childcare as a Political Issue During an Election Year – and Beyond. Asia-Pacific Regional Network for Early Childhood (ARNEC). [Webinar].

https://arnec.net/events/webinar-elevating-childcare-political-issue-during-election-year-and-beyond

Wilton, K., & Murphy K. (2017). Parenting in displacement adapting Vroom for displaced Syrian families. International Rescue Committee. Parenting in displacement adapting Vroom for displaced Syrian families | International Rescue Committee (IRC)

Case Study 3: User engagement as a catalyst for success

Given the rapidly-evolving digital landscape, user engagement has become an increasingly vital factor in the success of digital tools designed to support parents and educators. By fostering meaningful interactions and connections between users and their tools, digital platforms can help to recruit and sustain the involvement of target users. ParentText is a global automated messaging service that uses innovative approaches including gamification and customization to engage a broad range of users. In Pakistan, using the principles of Human Centered Design, Thinking Healthy tested and gathered user feedback to ensure that the final version of the tool reflected the needs and requirements of users seeking to improve maternal mental health.

ParentText (Jamaica, Malaysia, Philippines, South Africa)

ParentText is an automated messaging service developed by Parenting for Lifelong Health (PLH) designed to provide personalized information to parents and caregivers in low- and middle-income countries. The messaging service's content, derived from PLH's evidence-based parenting programs, aims to promote positive parent-child relationships, enhance child development and early learning, prevent violence, and improve caregiver mental health and well-being, as well as positive partner relationships. The content is tailored to local contexts, translated into multiple languages, and easily accessible through common messaging services like WhatsApp and Facebook Messenger. Currently, the tool has been soft launched in Malaysia, South Africa, Philippines, and Jamaica, with plans to expand its reach to Mexico, Thailand, Sri Lanka, and other Global South countries.

An important aspect of user engagement is ensuring that users with diverse abilities, backgrounds, and languages can utilize the tool. One way that ParentText enhances accessibility is by enabling users to choose whether they would like to receive text-based messages or a combination of text-based and multimedia messages (such as images, GIFs, and videos), depending on their preferences and data usage capabilities. Users can also select what time of day they would like to receive messages. Built on RapidPro, an open-source software, ParentText can also be accessed through the

most popular messaging platforms in the country where it is implemented, including WhatsApp, Telegram, and Viber, or SMS in areas with restricted internet access. This approach particularly benefits families with limited internet connectivity or low smartphone accessibility.

Customization can also enhance the user experience and make a tool more personalized and relevant to the user's needs and preferences. ParentText users have opportunities to select a goal and receive tailored messages which are gender and age responsive. There are six goal areas to choose from: relationship building, behavioral management, early learning and engagement in school, intimate partner violence prevention, keeping children safe, and emotional well-being for caregivers. After conducting an assessment to gather more information about the child or caregiver, customized messages are provided.

To further encourage user engagement, ParentText also uses gamification and brief check-in surveys. Users are awarded with badges and trophies after accomplishing different tasks and completing modules. Moreover, interactive quizzes and an emoji-based progress tracker keep users engaged. While initially PLH utilized weekly surveys to gather data, it now prioritizes brief check-ins and reflective questions to engage users and improve their experience while using the tool. Finally, ParentText tracks usage data which feed into efforts to innovate and improve its offerings so that they better support parents and caregivers. The PLH team is currently working on offering more targeted support to male caregivers, caregivers of children with disabilities, and families in migration. Furthermore, the organization is exploring potential ways for parents to receive real-time assistance, such as referrals to hotlines, community WhatsApp groups, or in-person onboarding, while also investigating how cultural determinants impact engagement in South Africa.

Thinking Healthy (Pakistan)

The Thinking Healthy program supports non-specialist service providers referred to as "peers" to deliver mental health interventions to mothers experiencing perinatal depression from pregnancy through one year postpartum. To help peers implement key ingredients of the program with expected quality, the Thinking Healthy app was developed in consultation with a 18-member design team comprised of three distinct groups - (i) an 'expert' group with mental health practitioners, (ii) a 'user' group with women who experienced perinatal depression, their husbands, and community health workers, and (iii) a 'technology' group with a software developer and graphic designer.

The design team applied principles of Human Centered Design (HCD), an approach that centers the end user in the design process, to design and test the tool in real-world settings. The three-step design process included:
- Step 1: To understand user requirements and preferences, the design team prepared a detailed storyboard with illustrations, scripts, and interface mockups. The team made rapid iterations to incorporate user requirements and arrive at a prototype for further testing.
- Step 2: The design team conducted "Cognitive walkthroughs," the technique of implementing tasks with a focus on the cognitive processes required to identify and address problems encountered while carrying out tasks required of the app and arrive at an advanced prototype.
- Step 3: A group of carefully selected end-users who represented the target population in real-world settings tested the prototype. A trained, independent team of researchers monitored and observed users interacting with the technology through short test cycles.

User feedback collected and incorporated along the way ensured that the final product was reflective of user needs and requirements. For example, upon the suggestion of the user group that the intervention should also bring in family members to support the mother, the design team modified the content of the intervention to be inclusive and promote messages of shared responsibilities in childcare activities.

Sources:
J.Lachman, personal communication, February 1, 2023

N.Atif, personal communication, February 8, 2023

Atif, N., Nazir, H., Sultan, Z.H., Rauf, R., Waqas, A., Malik, A., Sikander, S., & Rahman., A. (2022). Technology-assisted peer therapy: a new way of delivering evidence-based psychological interventions. BMC Health Services Research 22: 842. https://doi.org/10.1186/s12913-022-08233-6

Case Study 4: Generating M&E data for continuous improvement efforts

Digital tool developers and implementers use a range of methods to generate monitoring and evaluation (M&E) data which can be used to assess reach, user engagement, fidelity of implementation, impact on knowledge and behaviors, as well as to identify areas for improvement. The Bebbo app systematically collects monitoring data to better understand user uptake and usage of the tool as well as its effects on caregiver knowledge and behaviors. The Parent Education Program highlights how to use qualitative and quantitative evaluations to provide insights into the impact of chatbot-delivered messages on parents and spillover effects to other family members. These data have informed improvements in the design and delivery of both programs.

Bebbo (Europe and Central Asia)

The Bebbo app, developed by UNICEF, provides personalized information and tips about child development and caregiving to parents of children aged 0-6. The app is currently available in 14 countries across Europe and Central Asia. UNICEF uses a comprehensive framework to regularly monitor progress and evaluate impact of the app.

Uptake of the app is monitored through data from the app store on the number of installations and deletions. Activities undertaken by country offices to promote the app (e.g., through services providers, social media) are also tracked to observe the strategies that result in more downloads. Further, UNICEF also has data indicators to analyze if app downloads lead to usage. Usage data, collected by Google Analytics for Firebase, is focused on the patterns, frequency and length of use. This includes the total number of unique users by day and month, data on user retention, how often users access the app, and their duration of use. Firebase also helps track how often different features of the app (e.g., games and activities, milestones trackers) are used.

An online dashboard accessed by UNICEF country and regional offices is used to analyze trends in the data. The dashboard can also be filtered to obtain interesting trends in user uptake and usage based on user profile characteristics which includes information on their country, language of choice, relationship to child, and age group of child. Further, the changes produced by any new features introduced on the app can also be observed on the dashboard.

An embedded user survey also provides key data for M&E such as: place of residence, level of education, how users heard about the app, and if they are able to practice the tips they learn from the app. While users who complete the survey are likely the most engaged and thus not representative of all users, these data have been used to understand the extent to which users' awareness and practices across the thematic areas covered by the app have improved. Questions in the embedded user survey are changed on a regular basis to investigate patterns of the app use as well as potential impact of various features and the app in general. User surveys and feedback forms also generate valuable feedback on app performance, design and usability. To provide deeper understanding on the impact of the app on parenting practices, an online randomized control trial is being implemented in Bulgaria and Serbia.

More generally, UNICEF uses the data collected through these M&E practices to understand trends in user experience and to introduce new, responsive features in the app. For example, when it was discovered that engagement rates were initially low in a specific country, the team introduced translated content which led to an improvement in engagement rates. Similarly, before rolling out a new feature like push messages, different types of messages are tested to see what drives and increases engagement.

Parent Education Program (Jordan)

The Parent Education Program (PEP), aims at altering mothers' behavior to better support their children's learning and development in the critical first five years of life by equipping them with necessary awareness and practices. Delivered through Facebook Messenger, the chatbot is currently available in Jordan and neighboring countries. The Queen Rania Foundation for Education and Development (QRF), the developer of PEP, has designed frameworks for M&E to collect and analyze data that show the program's effectiveness in achieving its direct results and objectives. QRF also gathers user feedback and uses research insights to refine and iterate the chatbot. These M&E efforts enable the Foundation to continuously improve the program and ensure that it meets the needs of its target audience.

Through research and evaluation, PEP has evolved to meet the needs of its users. For example, QRF conducted a feasibility assessment in 2021 – including focus group discussions and in-depth interviews – which confirmed that all participants (166 mothers) heard about the program through Facebook. At the time, the chatbot was still being used through WhatsApp, but later shifted to Facebook Messenger to accommodate its users. Another assessment in 2022 based on the delivery approach of the tool, with six focus group discussions and six key informant interviews, found that Facebook Messenger was perceived to be 'efficient, simple, and direct' (IPSOS). Through pre and post assessments, QRF also found that users wanted more interaction. Facebook groups and leaderboards for each cohort were created to give space for parents to share pictures and videos of their families doing the activities.

QRF also collaborates with MMIS Management Consultants to conduct tracer studies of PEP participants. A 2022 study, with four assessment periods over the duration of nine months, evaluated knowledge, skills, engagement/application, self-efficacy, confidence, and spillover to other family members. Using both quantitative and qualitative research methods, MMIS conducted four focus group discussions and four in-depth interviews, as well as two digital survey questionnaires. The final survey sample included 119 mothers. The study found a significant positive change to the participants' knowledge and self-efficacy level between baseline and six months post-intervention. Moreover, the study revealed that users were motivated to engage in the program to acquire new skills and techniques to enhance their child's development. This was facilitated by the convenience of online participation and the status of QRF as a trusted organization. At the same time, users found it challenging to absorb all of the information available in PEP. Based on MMIS's recommendation to explain certain content areas, QRF updated some of the materials.

Participants were also asked about the spillover effects of the program on the behavior of people around them. More than three-quarters (77.3 percent) of married respondents believe their husbands interact with their child/children more as a result of participating in the program. Almost all (95.3 percent) of participants whose family members practice the learning and development activities with their children reported that the effect persists even after the program ends. Moreover, half of the mothers interviewed reported that their older children became more involved in caring for younger siblings. However, others reported obstacles to spillover effects such as lack of time and social barriers. As an example of how QRF incorporated the participant feedback, PEP now allows fathers to register to help boost their involvement in their children's development and learning. Additionally, QRF developed the course to be self-led which allows participants to learn at their own pace. In the future, there are plans to create a comprehensive app that provides parents with access to informative content, expert advice, and a milestone tracker, to offer further support.

Sources:
L.Chakhaia, personal communication, February 8, 2023

Ipsos. (2022). *PEP Delivery Approach & Self-Paced Program Assessment*. [Unpublished report].

MMIS Managment Consultants. (2022). *Parental Education Program (PEP) Monitoring and Evaluation -Tracer Study*: *Final Report.* [Unpublished report].

Queen Rania Foundation. (2021). *Feasibility Assessment: Parent Education Program (PEP)*. [Unpublished report].

References

Atif, N., Nazir, H., Sultan, Z.H., Rauf, R., Waqas, A., Malik, A., Sikander, S., & Rahman., A. (2022). Technology-assisted peer therapy: a new way of delivering evidence-based psychological interventions. *BMC Health Services Research* 22: 842. https://doi.org/10.1186/s12913-022-08233-6

Awah, I., Green, O., Baerecke, L., Janowski, R., Klapwijk, J., Chetty, A. N., Wamoyi, J., & Cluver, L. D. (2022). 'It provides practical tips, practical solutions!': Acceptability, usability, and satisfaction of a digital parenting intervention across African countries. *Psychology, Health & Medicine*, *27*(1), 107–123. https://doi.org/10.1080/13548506.2022.2113106

Bäckström, C., Engström, H., Knez, R., & Larsson, M. (2021). Digital tools as parental support—a study protocol describing prospective development and exploration of two digital tools for parents. *Frontiers in Digital Health*, *3*. https://doi.org/10.3389/fdgth.2021.698969

Balsa, A., Bloomfield, J., & Cid, A. (2022, November 22). *Technology meets face-to-face parenting workshops to create behaviour change*. Early Childhood Matters. https://earlychildhoodmatters.online/2022/technology-meets-face-to-face-parenting-workshops-to-create-behaviour-change/

Corralejo, S. M., & Domenech Rodríguez, M. M. (2018). Technology in parenting programs: A systematic review of existing interventions. *Journal of Child and Family Studies*, *27*(9), 2717–2731. https://doi.org/10.1007/s10826-018-1117-1

Cortes, K. E., Fricke, H., Loeb, S., & Song, D. S. (2018). Too little or too much? Actionable advice in an early-childhood text messaging experiment. *National Bureau of Economic Research*. https://www.nber.org/system/files/working_papers/w24827/w24827.pdf

DeWitt, A., Kientz, J., & Liljenquist, K. (2022). Quality of mobile apps for child development support: Search in App Stores and content analysis. *JMIR Pediatrics and Parenting*, *5*(4). https://doi.org/10.2196/38793

Dinarte-Diaz, L. (2023, April 12). *Some evidence-based practical tips for designing text-based parenting programs*. Development Impact. https://blogs.worldbank.org/impactevaluations/some-evidence-based-practical-tips-designing-text-based-parenting-programs?CID=WBW_AL_BlogNotification_EN_EXT

Early Childhood Development Action Network. (2021, December 9). What do we know (so far) about remote delivery of early childhood development programs in humanitarian settings? [Webinar]. https://ecdan.org/video/what-do-we-know-so-far-about-remote-delivery-of-ecd-programs-in-humanitarian-settings/

Early Childhood Development Action Network. (2022, November 16). COVID-19 Home Visiting Workforce Platform. https://ecdan.org/covid-19-home-visiting-workforce-platform/

Entenberg, G. A., Mizrahi, S., Walker, H., Aghakhani, S., Mostovoy, K., Carre, N., Marshall, Z., Dosovitsky, G., Benfica, D., Rousseau, A., Lin, G., & Bunge, E. L. (2023). AI-based chatbot micro-intervention for parents: Meaningful engagement, learning, and efficacy. *Frontiers in Psychiatry*, *14*. https://doi.org/10.3389/fpsyt.2023.1080770

Entsieh, A. A., Emmelin, M., & Pettersson, K. O. (2015). Learning the ABCs of pregnancy and newborn care through mobile technology. *Global Health Action*, *8*(1), 29340. https://doi.org/10.3402/gha.v8.29340

Fricke, H., Kalogrides, D., & Loeb, S. (2018). It's too annoying: Who drops out of educational text messaging programs and why. *Economics Letters*, *173*, 39–43. https://doi.org/10.1016/j.econlet.2018.08.029

Hackett, K., Proulx, K., Alvarez, A., Whiteside, P., & Omoeva, C. (2021). *Case studies of programs to promote and protect nurturing care during the COVID-19 pandemic*. FHI 360. https://www.fhi360.org/sites/default/files/media/documents/resource-lego-case-study-nurturing-care-report.pdf

Ipsos. (2022). *PEP Delivery Approach & Self-Paced Program Assessment*. [Unpublished report].

Kachergis, G., Hembacher, E., Cristiano, V., Zhang, H., & Frank, M. (2020) Understanding the impacts of video-guided activities on parent-child interaction. https://doi.org/10.31234/osf.io/dmeza

Kanders, K., Hickman, M., & Bazalgette, L. (2022). *Could parenting apps help improve outcomes for children?* Nesta. https://www.nesta.org.uk/project/mapping-parenting-technology/could-parenting-apps-help-improve-outcomes-for-children/

Korin, A., (2021). *Using edtech to support learning remotely in the early years. Rapid literature review of evidence from the global response to Covid-19.* (Helpdesk Response No. 31) EdTech Hub. https://doi.org/10.5281/zenodo.4746391

LaMonica, H. M., Crouse, J. J., Song, Y. J., Alam, M., Ekambareshwar, M., Loblay, V., Yoon, A., Cha, G., Wilson, C., Sweeney-Nash, M., Foo, N., Teo, M., Perhirin, M., Troy, J., & Hickie, I. B. (2022). Developing a parenting app to support young children's socioemotional and cognitive development in culturally diverse low- and middle-income countries: Protocol for a co-design study. *JMIR Research Protocols*, *11*(10). https://doi.org/10.2196/39225

LeFevre, A. E., Shah, N., Bashingwa, J. J. H., George, A. S., & Mohan, D. (2020). Does women's mobile phone ownership matter for health? Evidence from 15 countries. *BMJ Global Health*, 5(5), e002524. https://doi.org/10.1136/bmjgh-2020-002524

Minderoo Foundation. (2022, Nov 25). *Co-Design Is Key: A New Scientific Report Details Thrive By Five International's Unique Localisation Approach.* https://www.minderoo.org/thrive-by-five-international-program/news/co-design-is-key-a-new-scientific-report-details-thrive-by-five-internationals-unique-localisation-approach/

MMIS Managment Consultants. (2022). *Parental Education Program (PEP) Monitoring and Evaluation -Tracer Study*: *Final Report.* [Unpublished report].

Queen Rania Foundation. (2021). *Feasibility Assessment: Parent Education Program (PEP)*. [Unpublished report].

Rubio-Codina, M., & López-Boo, F. (2022). *What have we learned from the design and delivery of remote and hybrid early childhood development services during the pandemic?* Inter-American Development Bank. https://publications.iadb.org/publications/english/document/What-Have-We-Learned-from-the-Design-and-Delivery-of-Remote-and-Hybrid-Early-Childhood-Development-Services-During-the-Pandemic.pdf?download=true

The Early Learning Lab. (2017). *NextGen technology: Insights and recommendations to support the parents of children ages 0–3*. https://www.startearly.org/app/uploads/2021/10/REPORT_NextGen-Technology.pdf

UNICEF Information Communication and Technology Division. (2021). *Harnessing the power of technology and digital innovation for children*. https://pdf4pro.com/file/13c178/media_100211_file_DIGITAL_UNICEF.pdf.pdf

UNICEF, World Health Organization, Parenting for Lifelong Health, End Violence Against Children, & Early Childhood Development Action Network. (2021). *Global initiative to support parents inter-agency vision*. https://www.end-violence.org/sites/default/files/2021-06/Parenting%20Inter-agency%20Vision%20Final%20%281%29.pdf

Weatherill, J., Pragita, M., Wat, A., Taneja, A. (2022, June 23). Elevating Childcare as a Political Issue During an Election Year – and Beyond. Asia-Pacific Regional Network for Early Childhood (ARNEC). [Webinar]. https://arnec.net/events/webinar-elevating-childcare-political-issue-during-election-year-and-beyond

Wilson, K., Nelson, A., Craig, T., Hofmann, R., & Layer, L. (2020, Nov 5). *Jamii ni Afya*: using digital tools to scale integrated services to mothers and children in Zanzibar. Early Childhood Matters. https://earlychildhoodmatters.online/2020/jamii-ni-afya-using-digital-tools-to-scale-integrated-services-to-mothers-and-children-in-zanzibar/#author-allyson-nelson

Wilton, K., & Murphy K. (2017). Parenting in displacement adapting Vroom for displaced Syrian families. International Rescue Committee. https://www.rescue.org/report/parenting-displacement-adapting-vroom-displaced-syrian-families

Zhang, D., & Livingstone, S. (2019). *Inequalities in how parents support their children's development with digital technologies: Parenting for a digital future* (Survey Report 4). LSE Department of Media and Communications. https://www.lse.ac.uk/media-and-communications/assets/documents/research/preparing-for-a-digital-future/P4DF-Report-4.pdf