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ABSTRACT

User participation is often time and resource intensive for both the designers and participants. This is especially problematic in cases where designers and users are not co-located and have to travel to participatory meetings. Distributed co-design through remote participation technologies has been hoped to alleviate these issues. However, distributed co-design has its own issues, such as requirement of an access to suitable technology independently by the participants. In this paper we present three cases where distributed co-design has been mediated through WhatsApp™, the currently most wide-spread mobile instant messaging app. Our lessons learned from these projects indicate that mobile instant messaging has potential in distributed co-design, and the continuous access to communication channels can enable detailed discussions between the designers and the participants. To summarise our findings, we present a framework to help future academics and practitioners to plan and implement (part of) their co-design process in mobile instant messaging services.

CCS CONCEPTS

• **Social and professional topics** → *Geographic characteristics*; • **Human-centered computing** → *Empirical studies in collaborative and social computing*.

KEYWORDS

mobile instant messaging, case studies, distributed co-design

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1 INTRODUCTION

Co-design with disadvantaged communities has always aimed to empower the previously disadvantaged through the design of new technologies, items, and services [50]. Co-creation of new technical artifacts that fit the context and answer the needs of the users, can help the users in disadvantageous positions to achieve better conditions for themselves. Such new, well-suited technologies can also empower users by leveraging their existing resources to their full potential, allowing for more efficient use [35]. Novel methodologies of participating local communities can provide new perspectives to the design of new digital services [23]. Therefore, exploring the limits and possibilities of the co-designing methods is a worthwhile task in itself.

While the roots of the co-design are in the participatory design that was born in workplaces of the Global North, it has been increasingly used in the Global South to help local communities create empowering and context-fitting technology [16]. Traditionally, participatory design projects have been resource-intensive affairs [38]. Designers have been encouraged to create long-lasting and intensive relationships with the communities they work with [46]. While such engagement can definitely be rewarding for both designers and participants, it also requires a significant amount of resources. In international design collaborations in which designers must travel to meet participants, both money and time resources might be insufficient. Even in locally anchored projects, the geographic spread of participants combined with unreliable transport

infrastructures and the tight schedules of the intended beneficiaries can render face-to-face interactions cumbersome or impossible. Hence, exploring ways to make co-design processes more accessible would enable more communities to experience the empowerment through co-designed technology.

In this paper, we aim to find practical ways to make co-design less resource-intensive. Remote participation and distributed co-design (DCD) have understandably been a topic of interest recently due to the Covid-19 pandemic. While there have been worries, that DCD would make participation less efficient, Perikangas and Tuurnas have demonstrated that digital participation can be inclusive when the facilitators consider the limitations that a digital environment presents for the design process [32]. We have also been encouraged by Whittle, who has argued that "lighter" participation can create good outcomes if the participation is planned well [45].

While DCD has potential to make participation more accessible also for disadvantageous communities in the Global South, there have been concerns raised on the technical requirements of DCD processes [12]. However, mobile instant messaging (MIM) services, such as WhatsApp™, Telegram™, and Signal™ are increasingly used for both private and work-related communication in the Global South [9, 36]. In particular, WhatsApp™, a MIM service owned by Meta, is already widely adopted. In fact, in many areas of the Global South, WhatsApp™ is becoming part of local infrastructure [9], as data used by the application is sometimes offered as zero-rated [7]. WhatsApp™, as well as other MIM services, can be used on a wide variety of smartphones and offers a relatively large variety of features. These factors make MIM services an interesting and practical platform for participation.

In this paper, we examine how MIM can be used as part of DCD. We do this by presenting three cases of international co-design projects facilitated partly via MIM. The first case, SaIAFarms, located in India, aims at developing an irrigation advice mobile application for local small-holder farmers with limited water resources. The second case, Fusion Grid, is located in Namibian informal settlement, where a local power grid has been developed for inhabitants previously lacking electricity. The third case, EWOK, also located in India, aims at creating new livelihoods for rural communities to support their farming incomes. Together these cases illustrate how MIM can be used in remote co-design projects. The aim of this paper is to provide an understanding of the best practices for the usage of MIM in DCD. We discuss how the platform should be used to support participation and identify the potential downsides of MIM usage. These questions are discussed from both theoretical and practical points of view.

While WhatsApp™ is the most used MIM service, and we have made use of it in our research, practically any MIM services affords designers the same possibilities. The attributes of WhatsApp™ that are important in our research, such as ease of use, efficient data usage, primarily mobile usage, and the ability to share videos and images are also present in other MIM services. If WhatsApp™ ceased to exist, all the cases we present as well as the analysis we based on them would still remain relevant for future researchers and practitioners.

The rest of the paper is structured as follows: in the next section, the background literature regarding to the DCD and MIM in the Global South as well as the research question are presented. This is followed by the case selection and the explanation of used methods. Then, in the Section 4, the three cases of this paper are explained. This followed by the Analysis section, where the common themes in the cases are defined. Based on these common themes, we present a framework of MIM-based DCD process in the Section 6. The discussion on the benefits and the potential issues of the MIM-based DCD are located in the Section 7. The paper is then finished with brief conclusions.

2 BACKGROUND

In this section, the related research of this paper is presented. In Section 2.1 the state of art regarding DCD is presented, and in the Section 2.2 the usage MIM in the Global South context is explained. Based on these sections, the gap in the existing literature as well as the research question are presented in the Section 2.3.

2.1 Distributed Co-Design

Co-design is a "process of collaborative design thinking: a process of joint inquiry and imagination in which diverse people jointly explore and define a problem and jointly develop and evaluate solutions" [41]. Actual participation in these processes occur through interaction between the designers and the participants with a goal of designing new artifacts. These methods of interaction range from free-flowing workshops to participant interviews [45]. The importance of the interaction between the designers and participants is one of the core elements of the co-design.

Co-design conducted in its traditional form is often resource-intensive [38, 45]. This intensiveness might make co-design process inaccessible for participants experiencing various limitations. The limitations of participation experienced by the participants range from lack of shared understanding and language [50] to the disabilities of the participants [21]. In intercultural co-design projects, designers need to travel to meet participants [46], which often requires both time and money from the designers. However, the participants often experience limitations in these projects as well. If the participants come from underprivileged communities, they might not be able to devote time for participating in co-design activities [5]. The would-be participants might be needed in household tasks, earning livelihoods, or doing care work while the participatory processes take place [46]. Creating co-design processes that ease the cost of participation for both the designers and participants could improve the accessibility to the empowerment happening through co-design.

Therefore, it is understandable that participatory projects involving remote tools are expected to ease these requirements for both designers and participants [18, 25]. In DCD, the interactions between participants and designers have been transferred to online environments. These environments range from video calls [37] and social media platforms [34] to dedicated participation platforms [44]. DCD is often divided into synchronous and asynchronous models: synchronous co-design takes place at the same time, while asynchronous co-design does not require temporal coordination [22]. There have been promises, that DCD would enable participation by individuals who would not be able to participate in

traditional co-design processes [18]. Thus, the potential of remote participation is worth investigating for the PD community.

The role of technology in the DCD is to enable the same type of interactions between designers and participants that would otherwise be conducted in face-to-face settings. The technology needed to support these methods in remote work has existed and been widely available for well over a decade. For example, the potential of social media in co-design was already discussed in the ACM's CHI conference on Human Factors in Computing Systems in 2007 [29]. Even then, co-design scholars speculated that social media could be used to facilitate ongoing dialogue between designers and participants [20]. However, it appears that despite initial interest towards DCD, there have been relatively few co-design projects reported that have used remote elements. Researchers have emphasised that real-life interactions between the participants and the designers tend to create a more intimate research setting than the distributed technologies could provide [49]. In addition, the contextual understanding that designers can gain when meeting with participants in real-life environments has been valued in PD projects [46]. While interest in DCD has not fully ceased (i.e. the DisCo project by Walsh et al. [44]), these practices have mostly remained on the fringes of the general PD discussion.

Due to the recent COVID-19 pandemic, there has been a sharp increase in the interest towards the DCD. This has been reflected also in the field of co-design, where physical meetings with participants had suddenly become impossible [24, 37]. Due to its remote and online nature, DCD has enabled interactions that would not have been feasible or even possible in face-to-face settings [18], which appear one of the key benefits of DCD projects. There have also been several DCD projects in which children are the end users [22, 33, 47]. Children often lack the ability to independently participate in design sessions if they are not held in locations close to them. Therefore remote technologies seem to enhance the ability of the designers to get the children's input on design [4, 8]. Based on the work of Druin [11], Fails et al. presented four dimensions of tension in their DCD project with children [13] that characterize much of the DCD literature: scale vs. intimacy of design, shifting roles as mediated through technology, freedom and autonomy, and meeting physical interaction needs. These dimensions are present in much of the DCD literature.

The technology in DCD does not have to be complicated. In 2012, Hargreaves and Robertson reported promising results on the use of remote tools to rapidly create prototypes with participants [15]. Often the DCD takes place on video calls (for example: [13, 18, 47]). In order of participating in DCD, the participants need to be able to independently access, and use the technology where the remote participation is based. The lack of access to technology is a known issue in DCD [12]. There have been attempts to solve this issue. For example, Fails et al. have provided their participants with tables and necessary applications to ensure their potential participation [13]. However, there are little examples of DCD taking place on MIM, which is already used by many potential participants. The only mention in the literature we found was by Slingerland et al., who briefly mention using WhatsApp™ to support their communication with the participants [37]. However, the features of MIM (explained in the next section) have not been fully examined in the existing DCD literature.

2.2 Mobile Instant Messaging in the Global South

MIM have become an important and often preferred communication channel in many communities in the Global South. MIM enables their users to communicate with each other via text, images, and videos through data access. VoIP calls are also possible in these services [31]. With over 2.44 billion users globally, WhatsApp™ is currently the most used MIM service [39]. Its use is especially prominent in the Global South, where the application is often one of the most important methods of communication [9]. For example, in India, the penetration of WhatsApp™ is over 97% as of 2022 [40]. The wide penetration makes MIM a powerful tool of communication in the Global South.

Especially WhatsApp™ has been adopted to the usage in the Global South. For example, in Namibia, local mobile operators offer separate data packages for data used in WhatsApp™ and other social media [2]. The price and the amount of data in these packages mean that WhatsApp™ usage is practically unlimited for users. With such a pricing model, WhatsApp™ data has increased the application's usage in South Africa [7]. WhatsApp™ is perceived as easy to use [17], and available on low-end phones [1], making it well suitable for users in the Global South.

MIM enables discussion not only between two individuals but also among larger groups. These groups can either be representations of friend groups, communities or families [26], or be centred around common interests. For example, in Brazil WhatsApp™ groups are used to connect with various groups ranging from friends to workmates and shared sports fandoms [14]. MIM discussion groups have become an important way to share news [43]. Furthermore, political dissidents perceive WhatsApp™ as a safe space for expressing their views [30]. In Nigeria, the local women have empowered themselves by connecting with each other in WhatsApp™ groups [3]. Cruz and Harindranath argued that WhatsApp™ is so intertwined in all aspects of social life in Mexico that they call it the "technology of life" [9]. All in all, MIM groups form an important channel to share news and experiences within and between communities.

Besides personal use, MIM is widely used in business context [36]. For example, in rural Namibia, a San community starting a campsite selected WhatsApp™ over emails or phone calls as a preferred way of communicating with potential customers [19]. The application forms a technical backbone for the Rwandan media, from finding news and respondents to coordinating the newsroom operations [28]. WhatsApp™ is also utilised in internal business communication by companies [27]. Indian farmers use WhatsApp™ to share news and support each other [10]. These ways of usage demonstrate that the users in the Global South are willing to extend the domains of MIM use from personal life to other areas of life. This could also mean, that MIM could be used in research communication, although there are little examples of this in the literature.

2.3 Gap in Knowledge

As argued in Section 2.1, the DCD offers many promises and benefits. It can be used to participate in groups that would otherwise be difficult to reach [4, 8, 18], therefore increasing the accessibility of co-design. DCD can also alleviate logistical issues in international co-design projects, as it addresses the need for designers to travel and meet participants. Thus, exploring possibilities within DCD is a worthy aim for the field of co-design.

However, in order of the users to participate in DCD process, they need to have an access to the technology [12]. DCD does not necessarily require complicated technical systems to operate, but the users need to be able to use the required technology independently. Correspondingly, as explained in Section 2.2, WhatsApp™ has been widely adopted across large parts of the world for various use cases.

Despite the potential of MIM to increase the inclusivity of DCD processes, this topic has not been explored. This paper addresses that gap, and explores how MIM can be intertwined into DCD methodologies. Therefore, the research question for this paper is:

"How can mobile instant messaging be used in distributed co-design?"

3 CASE SELECTION AND RESEARCH METHODOLOGY

3.1 Case Selection

In order to answer this research question, we analyse three cases where MIM (namely: WhatsApp™) have been utilised in DCD. All three case projects presented in this section have used co-design methodologies or – in the case of EWOK – were inspired by co-design ideas. None of these cases consciously began as a study of MIM in DCD. Rather, in all of these cases, MIM was implemented to solve a practical problem in the design process.

Together these cases present a varied and nuanced outlook to the possibilities of MIM in DCD. They have different aims, and varying degrees of success in terms of reaching their goals. These cases are also in different states of operation. The cases are summarised in the Table 1, and further described in Section 4.

Table 1: Cases of Mobile-Instant Messaging based Distributed Co-Design processes

Case	Location	Aim	State
SaIAFarms	Kamand Valley, Himachal Pradesh, India	Co-designing a mobile application for providing irrigation advice with local farmers	Early state
Fusion Grid	Oniipa, Northern Namibia	Co-designing rules and practices for managing a community-owned solar power grid	Concluded
EWOK	Kamand Valley, Himachal Pradesh, India	Creation of rural livelihoods with local female farmers	Continues in mature state

3.2 Research Methods and Data

As the three different cases were implemented without explicit intention to explore MIM-based DCD, the research methods were not targeted or coordinated with this topic in mind. However, as the co-design in two cases (SaIAFarms and Fusion Grid) was part of the research project, the co-design and the usage of MIM as part of it were documented in a scientifically sound manner as is described below. For example, the workshops that preceded the establishment of the WhatsApp™ groups were recorded, and the transcripts of the WhatsApp™ discussions have been stored.

The third case (EWOK), which involves a local NGO, did not document their work as rigorously as the other two cases. We therefore implemented a systematic debriefing with two of the other authors. This debriefing was recorded.

Our research method can be described as a meta-analysis: qualitative research is often aggregated in form of multiple case studies [48], that are typically designed to triangulate a specific research question, or meta-ethnography [6] aggregating published research. The approach used here is a hybrid between the two: Research on each case took place independently of the others. However, as we address a research question that has not been core to any of the research published, we re-analysed our original field materials.

The analysis of the cases was done in online discussions of the authors. All authors familiarised themselves with all of the cases. In the following discussions we found common elements in the structure of the MIM usage, and in the considerations of the advantages and disadvantages of the MIM in DCD. These themes were used by the researchers involved in each case to identify relevant data and episodes from their field material. The results of this distributed thematic analysis in turn were used to refine the themes. These themes were then used for a second round of project specific analysis. The thematic analysis is presented in the Section 5.

4 MOBILE INSTANT MESSAGING IN DISTRIBUTED CO-DESIGN: THREE CASES

In this section, we present the three cases. The description of each case begins with a short overview that provides a brief account of the aim of the project as well as the position that the authors held with respect to the case. This is followed by the description of relevant research activities and the use of MIM in the project.

4.1 Satellite-Based Irrigation Advice in Himachal Pradesh (SaIAFarms)

4.1.1 Project Scope: Satellite-Based Irrigation Advice. The SaIAFarms project is a bilateral project between the IT University of Copenhagen, DHI (a world-leading Danish research and development company in the field of water modelling), and IIT Mandi in India. It explores the deployment of satellite image analysis for irrigation advice for small-holding Himalayan farmers. About 81% of the total cultivated area in Himachal Pradesh comes under rainfed region, and farmers mainly rely on mountain streams and rainfall

to irrigate their crops. This project aims to develop a mobile application that provides irrigation advice for farmers based on the satellite image analysis.

SaIAFarms started in Spring 2021 and will conclude in 2024. The project is based on the long-term collaboration between IIT Mandi and a group of small-hold farmers in nearby villages. The farmers that participated the piloting of the application prototype were from villages of Salgi and Nehri, both of which were located in the outskirts of the campus area. Participating farmers worked in maintenance duties on the campus, and did small scale farming in their villages. These villages depended mostly on the rainfall to water their plants.

Four authors are members of the project: two are from the IT University of Copenhagen and two are from the IIT Mandi. The authors from IT University of Copenhagen are a Finnish post-doc, and German professor, who has been involved in collaborations with IIT Mandi since 2010. They both have experience on co-design projects with disadvantages communities. The authors from IIT Mandi are a doctoral student, and her supervising professor from the field of plant biology. They have been collaborating with the local farmer groups since 2017. All authors but the Finnish post-doc (who joined the project in fall of 2022) have been with the project from the very beginning.

4.1.2 Research Activities and Usage of Mobile Instant Messaging. From the very start, the project implemented a co-design approach in the development of the application. The design work began with workshops with farmers in April 2022 that focused on understanding and exploring current farming and water management practices. These workshops were located in farming communities near the university. Five farmers and three researchers took part in the study per village.

Based on this developed understanding, the designers presented the farmers with various paper prototypes that represented the possible user interfaces of the application. This design activity aimed to improve the understanding of how farmers would like to see their fields represented in the application. This workshop was organised in the IIT Mandi campus, where all the farmers worked supporting roles. The meeting was attended by twenty farmers, and three researchers. All meetings and workshops with the farmers were organised in Hindi, and the local researchers acted as translators between the participants communicating in Hindi and the foreign researchers with no Hindi skills. All discussions were recorded or documented through detailed field notes.

The initial co-design workshops indicated the need for a different channel to accompany the pilot usage of the app: many of the farmers had daytime jobs, and it was difficult to organise workshops either at the IIT Mandi or at the villages. Parallel to the design activities, a series of interviews was implemented that focused on the digital literacy of Himalayan farmers. The answers in these interviews and discussions with members of EWOK (the third case's organisation, as described below) indicated a prevalent usage of WhatsApp™ in the local communities. To solve the logistical issues of co-design of the irrigation application, it was decided that the use of WhatsApp™ be explored in the co-designing of the application. An additional reason for this decision was that it provided an asynchronous channel that was close to the farmers' daily life. The farmers and the researchers would be able to discuss current topics of application development on a free schedule.

In the spring of 2023, a working prototype of the application was developed, and five farms were selected as pilot farms. A meeting involving four farmers and three researchers was organised at the IIT Mandi. In that meeting, the farmers were introduced to the mobile application prototype, and it was installed on their smartphones. During the meeting, the farmers complained that they would like to receive more water management equipment in addition to the mobile application. However, the researchers mentioned that providing them with equipment was impossible within the funding frame of this project. At the end of the meeting, a WhatsApp™ group with all the farmers and the researchers was formed. A fifth farmer was introduced to the application when the researchers visited him in his village the following day.

In the meeting, it was agreed that the communication in the WhatsApp™ should be in Hindi. It would be possible to use Latin Hindi script. The foreign researchers without Hindi skills would be using Google Translate™ to communicate in the group.

At the beginning of period in which the WhatsApp™ group was used, the researchers posted there frequently and received short answers from two participants. However, two weeks after the piloting began, the back-end of the prototype application ceased to work due to the limitations of the free deployment environment used. It took a surprisingly long time to arrange for a different deployment option. During this time, the researchers attempted to keep the farmers engaged. Furthermore, the use of the pilot deployment suffered due to the lack of drought and the heavy rainfall occurring from May to August 2023 in the Himalayan region, which meant that the application was not needed by the farmers. When the fix took longer than anticipated, the researchers slowly stopped posting announcements of delays. This led the WhatsApp™ group to grow completely quiet. The SaIAFarms team decided to wait on the revival of the DCD for the next dry season and to instead use the time to consolidate the technology.

4.2 Solar Power and Connectivity in Northern Namibia (Fusion Grid)

4.2.1 Project Scope: Solar Energy and Mobile Network Connections. The Fusion Grid project (2018–2020) introduced and experimented a community-installable and community-run system for integrated provisioning of electricity, mobile connectivity and digital services. Such a system providing electricity for five households and internet access wider to the surrounding community was conceptualised and piloted in an under-served community near in Oniipa, northern Namibia. The participants of the pilot were lacking electricity in prior to this project. The project focused on availing energy access to support baseline provisioning of electricity for the households and the ICT equipment providing internet access for the target community. The experiment focused on the capacities of local communities in under-served regions to set up, operate and maintain solar-powered, off-grid micro-grids delivering electricity to the consumer appliances in the small energy community as well as to utilise digital services in the livelihood creation.

Four authors, all employed by Finnish universities, were involved in this project. Three of them were post-doc, doctoral student,

and his supervising professor, all whom had experience from co-designing digital services with disadvantageous communities. The doctoral student and the professor were Finnish, but the post-doc was originally from Namibia and the area of the study. Fourth author was a Finnish professor from different Finnish university with expertise in smart energy systems and off-grid microgrids.

4.2.2 Research Activities and Usage of Mobile Instant Messaging. The initial construction of the Fusion Grid pilot system took place in December 2019. The researchers travelled to the community and spent a week participating in the installation of the solar grid system. During this time, they met with all the collaborating participants and formed a WhatsApp™ group for communicating project updates to the group.

The use of WhatsApp™ was initiated during the initial installation and continued during the system upgrade of the solar-battery power system and the introduction of the micro-grid to the members of the community. The emergence of enthusiastic local technicians and contact persons paved the way towards the formation of WhatsApp™ groups for bi-directional communication to aid the development and on-site status monitoring of the micro-grid. WhatsApp™ was used for communication between individuals (researchers, technology support persons and contact persons in the local community) and groups (local energy communities, authorities and researchers).

Typically, general announcements on the status of and fault events in the electricity system were communicated to all participants via Whatsapp™. Also, questions about the status of the system were presented via groups, especially in situations in which the system experienced challenges with capacity. Individual communication took place especially in situations of system status exploration (e.g. unanticipated system behaviour) and system improvement. In cases of specific procedures (e.g. elaboration of steps involved in upgrades) and installation of new components (e.g. new outdoor WiFi bases station for internet coverage extension), WhatsApp™ provided a channel for the exchange of materials and documents, such as pictures and manuals.

Skype was the main tool used for real-time video collaboration within the project. Video-based interaction was especially important in major technology upgrades, most challenging anomaly explorations, and remote audits of installation works. Skype provided a communication application platform for group calls, while WhatsApp™ supported video calls for only three persons concurrently at maximum. Accordingly, under these specific conditions in 2019 and 2020, Skype was found to be more stable for video calls than WhatsApp™. Given such communication tools, the Fusion Grid pilot system operation and installation of additional features were completed successfully.

The use of WhatsApp™ was not limited to electricity monitoring, provisioning and planned project-specific issues only. The introduction of electricity in the community facilitated the initiation of new small businesses run by the participants. WhatsApp™ served as a means for marketing the products they crafted (e.g. furniture and wedding decorations) through the use of electrical tools supplied by the electricity from the pilot system, organising logistics, and hiring workers to expand small businesses.

An initial challenge in the project related to proper control and equal sharing of electricity among the participants. The voluntary control of electricity based on active monitoring of consumption with smartphones was not realised. Therefore, an automatic quota-based control feature was quickly developed to avoid further tensions among the members of the energy community. Another social surprise related to the open offering of internet in the neighbourhood was that its availability started to draw external people to the surrounding area, which made the locals feel uncomfortable with respect to safety. These issues, together with an incomplete model for sustainably financing internet connectivity, resulted in the closing of the offer of open internet access.

Participants reported these challenges in the WhatsApp™ group. The researchers then proposed solutions to be implemented and provided descriptions of how such solutions would work for the participants, who in turn commented on these plans. Based on these conversations, a web portal for managing electricity was created. The portal enabled the participants to monitor the consumed electricity of their own houses in real time. Due to non-finalised billing system during the project, households were assigned equally distributed quotas that were available on a daily basis.

Officially, the project ended in June 2020. To cater to the continuity of uninterrupted electricity supply and the high quality of the service, remote monitoring and support has continued since the end of the project. The WhatsApp™ group remained active for communicating the system status and solving issues until 2021.

4.3 Livelihood Creation with Farmers in Himachal Pradesh (EWOK)

4.3.1 Project Scope: Livelihood Creation with Local Farmers. Enabling Women of Kamand Valley (EWOK) is a voluntary organisation working besides IIT Mandi. It was founded in 2016, soon after the university itself was established in the area. Currently, EWOK is a team of four (an advisor and associates) that reaches over 100 local farmers.

The goal of EWOK is to help local women, who often are responsible for subsidiary farming for their families, diversify their livelihood sources by enabling the creation of new business models and by providing relevant training. EWOK works with several rural communities in the area. The EWOK team maintains an understanding on the agricultural products, and they support local farmers in the creation of new livelihoods in the area. EWOK has, for example, facilitated the lab-to-farm cultivation of aromatic plants as interventions to overcome wildlife menaces faced by farmers as well as additional income generation. The organisation has also helped farmers to bring their products, such as indigenous squashes and pickles, to local markets by providing mentorship.

Two of the authors of this paper are employed by EWOK. They have worked for the organisation for seven years, and in EWOK, they are responsible for overseeing the operations. Both of these authors are Indian. One of the EWOK authors is working for as a community leader, the other EWOK author is part of the board and agri-technology mentor to the EWOK registered farmers.

The case description below and the analysis is based on a systematic debriefing of the EWOK team, which has been recorded.

4.3.2 Research Activities and Usage of Mobile Instant Messaging. Since EWOK was founded, MIM has been used in their operations. WhatsApp™ was preferred, as EWOK members noticed how prevalent the application was among local farmers. Many farmers already used the application in their day-to-day lives; therefore, it was easy for them to adopt the application for communicating with EWOK. The Covid-19 pandemic also increased the penetration of the smartphones in the area, as many farmers were forced to get one to help their children to connect to the internet for remote schooling.

EWOK uses WhatsApp™ to post information to larger number of individuals simultaneously; this made the operations of EWOK more efficient. Through the application, they are able to connect to more farmers than they would otherwise be able to. In addition, the terrain in Kamand Valley is difficult to traverse. Visiting villages in person could easily take a whole day. WhatsApp™ enables more constant contact with the farmers than would be otherwise possible.

When EWOK begins work with a new community, they use already-existing WhatsApp™ groups in which it is possible to spread information about their work in the target community. These groups already have many prospecting members and have proven to be a good way to contacting farmers from a certain area. Farmers are often asked by EWOK employees to share images from their fields, which helps EWOK to provide them with suitable advice. This is occasionally enhanced through the use of video calls. Otherwise, farmers communicate mostly on text, usually using Hindi with Roman script. Voice messages are also rarely used.

EWOK has divided the farmers to WhatsApp™ groups according to the crops they grow. These groups are assigned to a certain EWOK employee who oversees the discussion. Communications are planned on the EWOK side according to the farming schedules they have created. It is possible that the discussion in the groups quiets down and reactivates according to seasonal farming schedules. Farmers also discuss the agriculture related topics on own initiative in these groups. For example, an individual farmer who experiments with new crops might share his or her experiences with the group.

The groups are meant for agriculture-related discussions, and sharing images, memes, greetings, and opinions on other topics is discouraged. However, this rule is not strictly enforced; during festive times, in particular, seasonal greetings are shared. These rules have not been explicitly communicated to the farmers, but farmers follow the example from group administrators and other participants. About half of the farmers actively participate in the discussions, while others remain mostly silent. New members are added to the groups by administrative EWOK workers. It is possible that these new members have not physically met EWOK workers before joining, and they assume the policies through observation. However, EWOK tries to keep the number of participants in the groups limited to maintain the community feel of the groups.

WhatsApp™, however, is not sufficient as the sole communication tool. There needs to be trust built in face-to-face meetings before WhatsApp™ can be efficiently used. In addition, WhatsApp™ messages often need to be accompanied by phone calls. In these phone calls, EWOK employees can make sure that the farmers notice the announcements that were sent. Farmers often have shared phones, which means that they might have time to check the messages only once per day. In addition, other users of the phone might sometimes mark the messages in WhatsApp™ as read, which makes it more difficult for the farmers to find the notifications.

5 ANALYSIS

When jointly analysing the MIM use across the three cases, we were ourselves surprised by the similarity of our experiences. Two commonalities, especially, emerged that then were used to structure the further analysis:

The first commonality involves the consideration that has preceded the utilisation of MIM. In all cases, WhatsApp™ was adopted because traditional ways of participation had become unsuitable for various reasons. As has been stated in the literature, DCD tools could increase access to co-design [18]; however, there are tradeoffs to be considered when comparing this with traditional methods [13]. In Section 5.1, we present the advantages and disadvantages of MIM-based DCD we encountered in the cases.

The second commonality relates to the process of the MIM-based DCD used. All the studied projects started with some kind of face-to-face interaction. In addition, all the projects also included either implicit or explicit agreements regarding the policies of the discussion in the WhatsApp™ group. Maintaining discussions with participants after starting the group also required work. Finally, there needs to be an understanding about if and when the participatory process will end. This process is analysed in the Section 5.2

5.1 Assessing the Suitability of the Mobile Instant Messaging Based Distributed Co-Design

5.1.1 Advantages of Mobile Instant Messaging Based Distributed Co-Design. The main advantage of MIM in DCD is its attainability, which was relevant in all three cases. In all cases, the participants already used WhatsApp™ as parts of their daily lives. There was no need for training or to provide additional resources for the users.

MIM also enables the remote communication between designers and participants. In two cases (SaIAFarms and Fusion Grid), the users of the technology were located on different continents than their participants. Also, in the case of EWOK, the participants would be difficult to reach physically because of the geographical features of the area. Without means of remote communication, this sort of collaboration would be impossible.

Another advantage of MIM is that it changes the dynamics of participation from separate sessions, making it a part of everyday life and supporting ubiquitous communication between designers and participants. The users do not need to wait to meet the designers again before addressing problems, but they can raise problems whenever they are encountered. In the Fusion Grid project, participants were able to immediately report issues in their electricity to the designers, who in turn promptly provided instructions on how to fix the issues. Similarly, EWOK uses WhatsApp™ to communicate with farmers who are on out on their fields. The farmers were able to immediately share their findings with the project workers.

The in-situ communication from the field led to rich and detailed discussions in which the users were able to clarify their problems

and be provided with detailed instructions on how to fix them. For example, designers in Global North were able to guide local participants who sought to upgrade their electric grids in the Fusion Grid project. This is also supported by the fact that MIM allows the sending and receiving of videos and images.

5.1.2 Disadvantages of Mobile Instant Messaging Based Distributed Co-Design. The participants' commitment to the DCD process has been found to be lacking. Their participation was less active than in the face-to-face settings. In the SaIAFarms case, there was a lack of responses from the farmers. While EWOK was more successful in their engaging farmers, only around half of the people in the groups participated in the discussion. Many of the smartphones of the farmers involved with EWOK were used by farmers' entire families. In some cases, especially at the beginning, it was necessary to call to participants in order to make sure that the recipient of a message got the chance to read the relevant messages in good time.

The designers also have less control and mediating capabilities online than in traditional face-to-face co-design. The interactions between designers and participants can drift into unproductive patterns, as designers have less means to steer the conversation and control the activities. For example, much of the limited face-to-face time in the SaIAFarms case involved designers explaining to the participants that it was not possible for them to provide new irrigation equipment within the scope of the project. The mostly remote process did not allow the participants and the designers to clearly discuss the project's scope. The lack of control might also lead to power struggles among the participants, that are difficult for the designers to manage remotely. In the Fusion Grid project, there was conflict among the participants about the sharing of the resources provided by the project. Solving these conflicts required additional remote interventions from the designers, as they were not able to travel to the location.

5.2 Process of Instant Mobile Messaging Based Distributed Co-Design

5.2.1 Start of the Process. All the cases started with different types of face-to-face meetings. In SaIAFarms project, the designers held short workshops with the participants, in which the application was presented and installed to their phones. In Fusion Grid project, the designers spent a week in the Oniipa community installing the solar energy and mobile networks while simultaneously familiarising themselves with the community members. EWOK in turn had already worked with the local farmers when they started to use WhatsApp™ in their operations. These meetings enabled the creation of WhatsApp™ groups used for participation.

Starting with a meeting, however, also serves a different function: it enables trust to be formed between the designers and the participants as well as among the participants. In the Fusion Grid project, the research team was able to familiarize themselves with all the participants individually. Because of this, they were able to understand the individual needs of the participants and provide them with necessary support. The research team was also able to identify the participants with the most technical skills and assign them to tasks involving remote grid maintenance over the course of the project.

5.2.2 Setting up Policies. In all three projects, policies were created to govern the conduct in the WhatsApp™ group. In our cases, these rules were established more or less implicitly. The designers provided an example of how to conduct themselves in the group and trusted that the participants would follow their example. They were successful in this, as there were no issues reported in any of the projects.

In our cases, two different policy decisions needed to be made: the language that was used, and how much informal discussion was allowed in the group. In EWOK and Fusion Grid cases, the language decision was straightforward, as the designers communicated with the participants by using common languages (Hindi in the EWOK project and English in the Fusion Grid). However, in the SaIAFarms project the foreign designers did not share a language with the participants. The designers suggested that that they would use Google Translate™ to translate their messages to Hindi before sending, a solution that was agreed upon by the participants. While this solution was functional, the lack of a common language might have been one of the reasons that the discussion did not take off in this case project.

The second policy decision that needs to be made was the policy regarding to informal and off-topic messages. These include both greetings, memes, and other posts shared to the group. EWOK discouraged their participants from sending these to the group, while Fusion Grid was more lenient towards these messages. It is worth noticing that in the EWOK project, the designers shared a cultural background with the participants, while in the Fusion Grid project, this was mostly not the case (except for one project member). The Fusion Grid project team lacked an understanding of the cultural nuances that would have been necessary in creating good policies to foster the discussion. In comparison, the EWOK team that shared a cultural background with their participants and were better able to create policies that fit the context they were in.

5.2.3 Maintaining Participation. Maintaining participation in the WhatsApp™ group after it had been instituted is critically important for the DCD project's success. If the designers and participants could not keep the participation going in the WhatsApp™ group after the group was started and the policies had been put into place, the project would not achieve its goals.

In all of the case projects, a percentage of the participants did not participate in the discussions after the start. About half of the participants actively took part in the discussions in the EWOK project. In the SaIAFarms case, ultimately none of the participants maintained participation after the start, which lead to current inactive state of the collaboration.

In our cases, it appears that a critical component in maintaining participation is that there were new topics to discuss in the WhatsApp™ group. In the SaIAFarms project, the mobile application that had been presented to the participants stopped working soon after the discussion group was started. Getting the application back to a functioning state took several weeks. Due to the unusually rainy weather, there was no need to monitor the water stress of the crops, either. The designers did not any have topics to bring to the group. This inactivity led to eventual inactivity of the group.

On the other hand, in the more successful Fusion Grid and EWOK projects, the designers were able to bring up new topics for the

participants to discuss. In the Fusion Grid project, the designers reported on the status of the electric grid to the participants regularly. This helped the participants participate in the discussion and therefore in the participatory process. In these discussions the designers were able to slowly shift the ownership of the grid to the participants. Similarly, in the EWOK project, designers constantly discussed rural livelihood themes with the participants. New initiatives (such as collecting pine needles to be pressed into briquettes) to keep the discussion alive. New seasonal discussion topics also emerged from the farming activities, as the participants brought up issues such as plant diseases into discussion without prompting.

5.2.4 End of the Process. Only one of our case projects reached the controlled ending: in the Fusion Grid case, ownership of the electric grid was slowly transferred to the local community, as was the aim of the project. The SaIAFarms team decided to wait on the revival of the DCD for the next dry season and used the time to consolidate the technology. EWOK in turn has continued their work with the local farmers without an end in sight.

The case of EWOK shows, that there is a need to decide whether there is an ending for MIM-based DCD or not. MIM lends itself well into facilitating continuous collaboration without well-defined end goals. If there are no limits in terms of time or other resources, it is possible that the same group of designers and participants continue constant collaboration. The collaboration in these type of projects mightbe less structured as the interaction progresses naturally rather than in more structured phases.

6 A FRAMEWORK FOR UTILISING MOBILE INSTANT MESSAGING IN DISTRIBUTED CO-DESIGN

Based on the three cases we have presented in this paper and the analysis in previous section, we summarise our learnings in the form of a framework to help fellow academics and practitioners assess the possibilities of MIM-based participation. This framework is an answer to the research question presented in Section 2.3:

"How can mobile instant messaging be used in distributed co-design?"

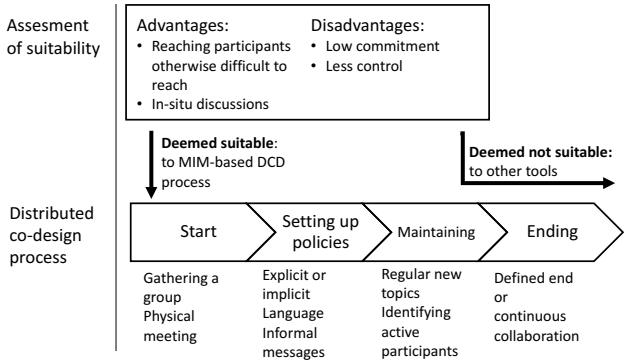

Figure 1: The framework of mobile instant messaging based distribute co-design.

In addition, this framework is our main contribution for the practitioners who are interested in finding new ways to efficiently implement DCD projects.

The framework (in Figure 1) has two parts. In the first part, the suitability of MIM is assessed. Based on the strengths and weaknesses of our MIM-based DCD and related work, we propose themes for that assessment. For projects deciding to utilise MIM in their DCD, we present the process of the participation as the second part of the framework. This framework is based on our limited experiences, and further testing is needed in future.

6.1 Assessment of Suitability

The main strength of the MIM-based DCD is its ability to reach communities that would be otherwise difficult to reach. We used MIM to engage in co-design process with communities that we would not have been able to physically reach. This is a well documented advantage in DCD literature [4, 8, 18]. In addition to physical reach, MIM has helped us save time. Participation in design is often hindered by the participants' lack of time to devote to the co-design process [19, 46]. MIM could help participants find time in their schedules, as the means of participation are mobilised.

The second advantage that we found in MIM-based DCD is the detailed and timely reporting from the remote contexts of use, e.g. a farmer's fields. This advantage is related to the attributes of MIM. Participants often have their mobile devices with them. Therefore they are able to share their experiences directly from the field, and enhance these comments with images and videos. This has opened new possibilities for rich interactions.

The disadvantages of the MIM-based DCD that we found are in line with the existing literature. As pointed by Fails et al., the participants' commitment to the co-design process might be low in remote process [13].

Additionally, designers have less control over steering the collaboration towards shared aims in DCD. In digital settings, participants have more autonomy to decide how they want to participate[13]. The designers need to closely monitor the MIM group in order of steering the discussion towards productive topics.

Based on these factors, the designers need to decide whether MIM is suitable for their DCD process. If it is found suitable, the designers can then start implementing the process of MIM-based DCD described in the following section.

6.2 Distributed Co-Design Process

If MIM-based DCD is deemed suitable for collaboration based on the factors presented in Section 6.1, we suggest using the following process.

(1) Start of the collaboration: The first step towards successful MIM-based DCD is to identify a group of suitable participants and to organise a physical meeting with them. In this meeting, the aim of the collaboration should be discussed, and the MIM group should be formed.
(2) Setting up policies: The policies of the MIM group can be discussed in the physical meeting. There should be a decision on the types of communication and topics appropriate for the group. The language might also need to be discussed. If these policies are not decided in an explicit manner, they can

also be established implicitly by acting as an example and trusting that participants adopt the protocol.
(3) Maintaining collaboration: Communication has to be kept alive by, for example, raising new topics or introducing new features. Otherwise there is a risk that discussion ends. Designers need to have a plan for creating these topics. In addition, the most active participants in the discussion should be identified and empowered as local champions.
(4) Ending the collaboration: If the project team wishes to eventually end the collaboration, there needs to be a shared understanding among the designers and participants about when this is expected happen. The limit can be set at a certain time, but it can also take place once the goal of the collaboration is achieved. However, it is also possible to use MIM for continuous development when no ending conditions are defined.

7 DISCUSSION

7.1 Benefits Using Mobile Instant Messaging in Distributed Co-Design

In all of our cases, and in the framework presented in the Section 6, the MIM was used to complement the more traditional co-design methodologies. All of our cases started with face-to-face meetings, where the remote collaboration was established. As such, we argue that the MIM-based DCD is at its best. MIM usage allowed us continue the collaboration with the participants for longer time, and over distances. MIM-based DCD cannot supplant the traditional co-design processes, as the commitment from the participants would likely be very low. However, as a part of the co-design process, MIM services offer additional possibilities.

In our work we found the following benefits of MIM in our co-design processes:

- The greatest strength of the MIM-based DCD is that it builds on the everyday technology that is already used by most of the participants. MIM is widely used in the global south. The participants are able to use the necessary technology independently, and the penetration is already high. While MIM services are relatively simple, they offer enough features to technically support the DCD process.
- The MIM-based DCD offers new forms of participation. As an asynchronous and mobile communication channel is relatively free from time and space constrains. The discussion can be joined at all times, and there is no need to travel to certain physical places to participate.
- The communication directly from the field (for example, installation of new parts to the electric grids in Fusion Grid project, or sharing images from the fields in EWOK) have enabled communication that is both precise and detailed.
- The participants have been able to take ownership of the created technology such as the policy creation in the Fusion Grid project demonstrate. The continuous discussion taking place on MIM group supported the transfer of ownership from the designers to the participants.
- In all of the cases, the prolonged co-design processes would not have been possible, as the participants and the designers have been located in different areas. The participatory process would have ended after limited number of face-to-face sessions, if there would not have been a practical way for the participants and the designers to continue discussing.

Based on these benefits, we argue that the MIM-based DCD expand co-design both with respect to time and space. Two of our cases have had positive outcomes. The failures in the third cannot be solely attribute to the distributed nature of the co-design process. While some of these benefits could also by using other means of digital communication, such as email, MIM offers an easily usable interface for participating in discussions, and sharing media such as images and videos directly from the field in a way that other platforms can not.

7.2 Potential Issues In Using Mobile Instant Messaging in Distributed Co-Design

Although our cases provide mostly positive examples of MIM usage in DCD, there are potential issues that might not have been explored in our fieldwork. Co-design is intrinsically linked to the concept of empowerment, which means allowing previously underprivileged users to achieve new liberties through the technology usage [50]. While it is possible that the participants of MIM-based DCD processes experience empowerment with the artifacts they have been co-designing, it is also important to examine who is left outside of the design processes.

MIM usage in the co-design process is not a silver bullet to solve al of the issues linked to the inclusion in co-design. In all of our cases, only part of the people who were in the WhatsApp™ groups participated in the discussions or otherwise meaningfully took part in the co-design process. The same gender power structures that may prevent participation in traditional co-design (for example: gender [46], class [16], race [42]) remain issues in remote settings. Additionally, one of the disadvantages of the MIM-based DCD is that the designers have less control over the process than in traditional co-design. It might be difficult for the designers to support the participation of the disadvantaged community members, when the collaboration takes place in virtual format.

Also, there might be potential participants, who would like to contribute to the DCD process, but are unable, as they do not have an access to the technology required to participate. This is a well known issue for DCD [12], and one of the main motivations for us to conduct this research is to reduce this issue by using MIM services that are in general accessible for many type of users. Still, it is possible that potential participants have been excluded due to our choice of technology usage.

One issue that we have not touched in this research is the privacy of the participants. MIM services are owned by multinational corporations, and not all participants might feel comfortable with sharing their opinions on mediums where they might be collected by third parties. Additionally, MIM groups can easily grow large. For example, EWOK has had to limit the number of participants in their groups. Large groups can feel intimidating for the participants to share their opinions. There is also a real risk, that these opinions can be shared to third parties outside of the group, which might have negative consequences for the participants.

7.3 Future Work: Towards Ubiquitous Participation

The framework presented above is based on only three cases. Therefore benefit from further research. In all of our cases, WhatsApp™ was selected as a tool because of its benefits for the co-design process. Systematically observing the role of MIM in the co-design process was not the focus of these cases. Therefore, research that explicitly focuses on the use of MIM in co-design from the beginning could result in changes to our framework.

All of our cases were located in disadvantageous communities in the Global South. In both EWOK and Fusion Grid cases the usage of the MIM began almost immediately after the collaboration began, and these communities had not participated in earlier co-design projects. These communities also lacked features, that would make them significantly different than other similarly sized and located communities in the Global South. Therefore, we see that the process of MIM-based DCD presented in the Section 6 can be used in other communities also.

However, it is worth noting, that our decisions to use MIM as a medium of DCD were informed by its accessibility, and the lack of other possible digital platforms. In a more resource rich environments, other platforms of participation, such as video calls, can lead to more fruitful participatory processes. If the future researchers decide to utilise MIM in their co-design projects, the framework presented in Section 6 should offer instructions.

Theoretically, our most important finding is related to the ubiquitous nature of participation through MIM. Literature on asynchronous modes of DCD exists, but in contrast to much of the technical solutions used in the literature, MIM services are mobile. Therefore, the participants maintained constant access to the channels of the participation. In two of our projects, this has implied that the discussions between the participants and the designers were rich and detailed. The participants were able to bring up issues immediately when encountered, and use images to depict them. However, the ubiquitous nature of the participation also meant, that the designers had to be constantly ready to react to the questions and discussions on the participation channel.

However, our results regarding ubiquitous participation are preliminary. While the changing dynamics of participatory interaction in these cases are interesting, our cases provide to a small sample to develop the theory of DCD further. Additional research on the process and the implications of ubiquitous participation is needed in the future.

8 CONCLUSIONS

In this paper, we have demonstrated through three cases how MIM can be used to facilitate DCD projects. MIM does not fit all co-design projects; thus, we suggest that designers consider carefully whether it fits theirs. Additionally, the MIM-based DCD is best used as a complement of other co-design methods. All of our cases showed the importance of having face-to-face meetings between the designers and the participates to establish the remote working channels, and to create trust and familiarity.

In the Section 6 we have presented a framework, that guides the implementation of the MIM-based DCD. This framework considers the advantages and disadvantages of MIM in DCD, and guides the process of the MIM-based DCD. Our experiences with MIM-based DCD have been mostly positive. The ubiquitous and continuous communication enabled by mobile devices has created rich and detailed discussions to our participation spaces. The comments straight from the field have allowed designers to provide advice and support in issues that the participants experience right at the moment. The design collaborations have also been sustained while the participants and designers have been located in different places. While our approach has disadvantages, such as low level of commitment and the designers' relative lack of control over the process, we are interested about the future possibilities that this approach could have.

The remote collaboration has made it possible for the designers to reach communities that would otherwise be difficult to reach. This increased access to co-design processes is valuable in itself, as it allows more communities to experience empowerment through technology design intervention. MIM services are almost as accessible smartphone applications as possible. Utilising MIM increases the inclusiveness of co-design processes.

Co-design processes aim at user empowerment. Broader access to this empowerment could have many positive impacts on the communities. In our cases, there have been examples of entrepreneurial activities and new business ideas being born in the communities we have collaborated with. These increases to the local livelihoods could be part of creating more equitable and sustainable future around the globe. Although MIM usage is not a silver bullet to solve all the problems typically experienced by DCD, we recommend that the future academics and participants to consider MIM as the medium of their DCD projects.

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REFERENCES

[1] 2023. Download WhatsApp for Android. https://www.whatsapp.com/android
[2] 2023. MTC Namibia Aweh product prices. https://www.mtc.com.na/prepaid/aweh
[3] Naima Hafiz Abubakar and Salihu Ibrahim Dasuki. 2018. Empowerment in their hands: use of WhatsApp by women in Nigeria. *Gender, Technology and Development* 22, 2 (5 2018), 164–183. https://doi.org/10.1080/09718524.2018.1509490
[4] Alissa N. Antle and Christopher Frauenberger. 2020. Child–Computer Interaction in times of a pandemic. *International Journal of Child-Computer Interaction* 26 (12 2020), 100201. https://doi.org/10.1016/J.IJCCI.2020.100201
[5] Niina Arvila, Heike Winschiers-Theophilus, Pietari Keskinen, Roosa Laurikainen, and Marko Nieminen. 2020. Enabling successful crowdfunding for entrepreneurs in marginalized communities. In *Proceedings of the 23rd International Conference on Academic Mindtrek*. ACM, New York, NY, USA, 45–54. https://doi.org/10.1145/3377290.3377303
[6] Nicky Britten, Rona Campbell, Catherine Pope, Jenny Donovan, Myfanwy Morgan, and Roisin Pill. 2002. Using meta ethnography to synthesise qualitative research: a worked example. *Journal of Health Services Research & Policy* 7, 4 (10 2002), 209–215. https://doi.org/10.1258/135581902320432732
[7] Ava Chen, Nick Feamster, and Enrico Calandro. 2017. Exploring the walled garden theory: An empirical framework to assess pricing effects on mobile data

usage. *Telecommunications Policy* 41, 7-8 (8 2017), 587–599. https://doi.org/10.1016/J.TELPOL.2017.07.002

[8] Aurora Constantin, Cristina Alexandru, Jessica Korte, Cara Wilson, Jerry Alan Fails, Gavin Sim, Janet C. Read, and Eva Eriksson. 2021. Distributing participation in design: Addressing challenges of a global pandemic. *International Journal of Child-Computer Interaction* 28 (6 2021), 100255. https://doi.org/10.1016/J.IJCCI.2021.100255

[9] Edgar Gómez Cruz and Ramaswami Harindranath. 2020. WhatsApp as 'technology of life': Reframing research agendas. *First Monday* (1 2020). https://doi.org/10.5210/FM.V25I12.10405

[10] Payel Das and Deepika Pradip. 2021. Usability and effectiveness of new media in agricultural learning and development: a case study on the southern states of India. *Journal of Social Marketing* 11, 4 (11 2021), 357–377. https://doi.org/10.1108/JSOCM-11-2019-0203

[11] Allison Druin. 2002. The role of children in the design of new technology. *Behavious & Information Technology* 21, 1 (2002), 1–25. https://www.scinapse.io/papers/5048401

[12] Salma Elsayed-Ali, Elizabeth Bonsignore, and Joel Chan. 2023. Exploring Challenges to Inclusion in Participatory Design From the Perspectives of Global North Practitioners. *Proceedings of the ACM on Human-Computer Interaction* 7, CSCW1 (4 2023). https://doi.org/10.1145/3579606

[13] Jerry Alan Fails, Dhanush kumar Ratakonda, Nitzan Koren, Salma Elsayed-Ali, Elizabeth Bonsignore, and Jason Yip. 2022. Pushing boundaries of co-design by going online: Lessons learned and reflections from three perspectives. *International Journal of Child-Computer Interaction* 33 (9 2022), 100476. https://doi.org/10.1016/J.IJCCI.2022.100476

[14] Ana Cristina Bicharra Garcia and Adriana Vivacqua. 2021. Should I stay or should I go? Managing Brazilian WhatsApp groups. *First Monday* (1 2021). https://doi.org/10.5210/fm.v26i2.10641

[15] Dean M. G. Hargreaves and Toni Robertson. 2012. Remote participatory prototyping enabled by emerging social technologies. In *Proceedings of the 12th Participatory Design Conference: Exploratory Papers, Workshop Descriptions, Industry Cases - Volume 2*, Vol. 2. ACM, New York, NY, USA, 25–28. https://doi.org/10.1145/2348144.2348153

[16] Christina N. Harrington, Sheena Erete, and Anne Marie Piper. 2019. Deconstructing community-based collaborative design: Towards more equitable participatory design engagements. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (11 2019). https://doi.org/10.1145/3359318

[17] Aycan Kaya, Reha Ozturk, and Cigdem Altin Gumussoy. 2019. Usability Measurement of Mobile Applications with System Usability Scale (SUS). In *Industrial Engineering in the Big Data Era: Selected Papers from the Global Joint Conference on Industrial Engineering and Its Application Areas, GJCIE 2018, June 21–22, 2018, Nevsehir, Turkey*. 389–400. https://doi.org/10.1007/978-3-030-03317-0{_}32

[18] Alison Kennedy, Catherine Cosgrave, Joanna Macdonald, Kate Gunn, Timo Dietrich, and Susan Brumby. 2021. Translating Co-Design from Face-to-Face to Online: An Australian Primary Producer Project Conducted during COVID-19. *International Journal of Environmental Research and Public Health 2021, Vol. 18, Page 4147* 18, 8 (4 2021), 4147. https://doi.org/10.3390/IJERPH18084147

[19] Pietari Keskinen, Marley Samuel, Helena Afrikaneer, and Heike Winschiers-Theophilus. 2021. A community-initiated website development project: promoting a San community campsite initiative. In *3rd African Human-Computer Interaction Conference*. ACM, New York, NY, USA, 1–11. https://doi.org/10.1145/3448696.3448698

[20] Morten Kyng. 2010. Bridging the Gap Between Politics and Techniques: On the next practices of participatory design. *Scandinavian Journal of Information Systems* 22, 1 (2010). http://aisel.aisnet.org/sjis/vol22/iss1/5

[21] Olivia Labattaglia, Stephen Reay, and Ivana Nakarada-Kordic. 2023. Co-designing accessible co-design. *Design for Health* 7, 3 (9 2023), 366–382. https://doi.org/10.1080/24735132.2023.2265239

[22] Kung Jin Lee, Wendy Roldan, Tian Qi Zhu, Harkiran Kaur Saluja, Sungmin Na, Britnie Chin, Yilin Zeng, Jin Ha Lee, and Jason Yip. 2021. The Show Must Go On: A Conceptual Model of Conducting Synchronous Participatory Design With Children Online. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 1–16. https://doi.org/10.1145/3411764.3445715

[23] Alex Jiahong Lu, Shruti Sannon, Cameron Moy, Savana Brewer, Jaye Green, Kisha N Jackson, Daivon Reeder, Camaria Wafer, Mark S. Ackerman, and Tawanna R Dillahunt. 2023. Participatory Noticing through Photovoice: Engaging Arts- and Community-Based Approaches in Design Research. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference*. ACM, New York, NY, USA, 2489–2508. https://doi.org/10.1145/3563657.3596041

[24] Franzisca Maas, Sara Wolf, Michael Weber, Marie Luisa Fiedler, Nils Zottmann, Marlene Lester, Jonathan Hohm, Luise Sessler, Katja Patricia Schmitt, Andreas Balser, Melina Joline Heinisch, Tabea Carolina Hofmann, Simon Maier, Amanda Ölschläger, Alisa Popp, and Jörn Hurtienne. 2023. "hubbel": A Hybrid Letterbox That Stimulates Civic Participation Through Local Information Sharing in Neighbourhoods. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference*. ACM, New York, NY, USA, 1826–1841. https://doi.org/10.1145/3563657.3596116

[25] Ezio Manzini and Francesca Rizzo. 2011. Small projects/large changes: Participatory design as an open participated process. *https://doi.org/10.1080/15710882.2011.630472* 7, 3-4 (9 2011), 199–215. https://doi.org/10.1080/15710882.2011.630472

[26] Mora Matassi, Pablo J Boczkowski, and Eugenia Mitchelstein. 2019. Domesticating WhatsApp: Family, friends, work, and study in everyday communication. *New Media & Society* 21, 10 (10 2019), 2183–2200. https://doi.org/10.1177/1461444819841890

[27] Moira McGregor, Nicola J. Bidwell, Vidya Sarangapani, Jonathan Appavoo, and Jacki O'Neill. 2019. Talking about Chat at Work in the Global South: An Ethnographic Study of Chat Use in India and Kenya. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300463

[28] Ruth Moon. 2022. Moto-Taxis, Drivers, Weather, and WhatsApp: Contextualizing New Technology in Rwandan Newsrooms. *Digital Journalism* 10, 9 (10 2022), 1569–1590. https://doi.org/10.1080/21670811.2021.1929365

[29] Pirjo Näkki. 2007. Utilising social media tools in user-centred design. In *CHI workshop on Distributed Participatory Design*. http://www.vtt.fi

[30] Gloria Anyango Ooko. 2023. In Pursuit of a "Safe" Space for Political Participation: A Study of Selected WhatsApp Communities in Kenya. *Journalism and Media 2023, Vol. 4, Pages 506-529* 4, 2 (4 2023), 506–529. https://doi.org/10.3390/JOURNALMEDIA4020032

[31] Nayankumar Patel, Swapnil Patel, and Wee Lum Tan. 2018. Performance Comparison of WhatsApp versus Skype on Smart Phones. In *2018 28th International Telecommunication Networks and Applications Conference (ITNAC)*. IEEE, 1–3. https://doi.org/10.1109/ATNAC.2018.8615445

[32] Sofi Perikangas and Sanna Tuurnas. 2023. Design for inclusive digital coproduction. *Public Management Review* (2023). https://doi.org/10.1080/14719037.2023.2224819

[33] Anita Reith, Anna Szilágyi-Nagy, Péter István Balogh, and Andrea Keresztes-Sipos. 2021. Report of a Remote Participatory Design Process to Renew a Schoolyard during COVID-19. *Journal of Digital Landscape Architecture* 6 (2021), 414–421. https://doi.org/10.14627/537705037

[34] Lill Francis Miranda Reyes and Sisse Finken. 2012. Social media as a platform for participatory design. In *Proceedings of the 12th Participatory Design Conference: Exploratory Papers, Workshop Descriptions, Industry Cases - Volume 2*, Vol. 2. ACM, New York, NY, USA, 89–92. https://doi.org/10.1145/2348144.2348173

[35] Hanna Schneider, Malin Eiband, Daniel Ullrich, and Andreas Butz. 2018. Empowerment in HCI - A Survey and Framework. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18*, Vol. 29. ACM Press, New York, New York, USA, 1–14. https://doi.org/10.1145/3173574.3173818

[36] Genevieve Sedalo, Henry Boateng, and John Paul Kosiba. 2022. Exploring social media affordance in relationship marketing practices in SMEs. *Digital Business* 2, 1 (3 2022), 100017. https://doi.org/10.1016/j.digbus.2021.100017

[37] Geertje Slingerland, Maria Murray, Stephan Lukosch, John McCarthy, and Frances Brazier. 2022. Participatory Design Going Digital: Challenges and Opportunities for Distributed Place-Making. *Computer Supported Cooperative Work: CSCW: An International Journal* 31, 4 (12 2022), 669–700. https://doi.org/10.1007/S10606-022-09438-3/TABLES/4

[38] Clay Spinuzzi. 2005. The Methodology of Participatory Design. *Technical Communication* 52, 2 (2005), 163–174. https://doi.org/10.1353/csd.2015.0028

[39] Statista. 2023. WhatsApp global unique users 2022. https://www.statista.com/statistics/1306022/whatsapp-global-unique-users/

[40] Statista. 2023. WhatsApp market share worldwide by country 2022. https://www.statista.com/statistics/1311229/whatsapp-usage-messaging-app-users-by-country/

[41] Marc Steen. 2013. Co-Design as a Process of Joint Inquiry and Imagination. *Design Issues* 29, 2 (4 2013), 16–28. https://doi.org/10.1162/DESI{_}a{_}00207

[42] Sepehr Vakil, Maxine McKinney de Royston, Na'ilah Suad Nasir, and Ben Kirshner. 2016. Rethinking Race and Power in Design-Based Research: Reflections from the Field. *Cognition and Instruction* 34, 3 (7 2016), 194–209. https://doi.org/10.1080/07370008.2016.1169817

[43] Susan A. M. Vermeer, Sanne Kruikemeier, Damian Trilling, and Claes H. de Vreese. 2021. WhatsApp with Politics?!: Examining the Effects of Interpersonal Political Discussion in Instant Messaging Apps. *The International Journal of Press/Politics* 26, 2 (4 2021), 410–437. https://doi.org/10.1177/1940161220925020

[44] Greg Walsh, Allison Druin, Mona Leigh Guha, Elizabeth Bonsignore, Elizabeth Foss, Jason C. Yip, Evan Golub, Tamara Clegg, Quincy Brown, Robin Brewer, Asmi Joshi, and Richelle Brown. 2012. DisCo: A Co-Design Online Tool for Asynchronoys Distributed Child and Adult Design Partners. In *Proceedings of the 11th International Conference on Interaction Design and Children*. ACM, New York, NY, USA, 11–19. https://doi.org/10.1145/2307096.2307099

[45] Jon Whittle. 2014. How much participation is enough? A comparison of six participatory design projects in terms of outcomes. In *Proceedings of the 13th Participatory Design Conference on Research Papers - PDC '14*. ACM Press, New York, New York, USA, 121–130. https://doi.org/10.1145/2661435.2661445

[46] Heike Winschiers-Theophilus, Shilumbe Chivuno-Kuria, Gereon Koch Kapuire, Nicola J. Bidwell, and Edwin Blake. 2010. Being participated - A community approach. In *Proceedings of the 11th Biennial Participatory Design Conference*. ACM, New York, NY, USA, 1–10. https://doi.org/10.1145/1900441.1900443

[47] Heike Winschiers-Theophilus, Naska Goagoses, Erkki Rötkönen, and Tariq Zaman. 2022. Pushing political, cultural, and geographical boundaries: Distributed co-design with children from Namibia, Malaysia and Finland. *International Journal of Child-Computer Interaction* 31 (3 2022), 100439. https://doi.org/10.1016/j.ijcci.2021.100439

[48] Robert K. Yin. 2013. Validity and generalization in future case study evaluations. *Evaluation* 19, 3 (7 2013), 321–332. https://doi.org/10.1177/1356389013497081

[49] Øivind Klungseth Zahlsen, Elena Parmiggiani, and Yngve Dahl. 2022. Challenges of Scaling Participatory Design: A Systematic Literature Review. In *Proceedings of the 34th Australian Conference on Human-Computer Interaction*. ACM, New York, NY, USA, 143–159. https://doi.org/10.1145/3572921.3572924

[50] Theodore Zamenopoulos, Busayawan Lam, Katerina Alexiou, Mihaela Kelemen, Sophia De Sousa, Sue Moffat, and Martin Phillips. 2021. Types, obstacles and sources of empowerment in co-design: the role of shared material objects and processes. *CoDesign* 17, 2 (4 2021), 139–158. https://doi.org/10.1080/15710882.2019.1605383