ABSTRACT

Title of Thesis:EXAMINING TECHNOLOGY TOOLS USEDIN ONLINE INTERGENERATIONALPARTICIPATORY DESIGN TEAMS

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Due to the recent COVID-19 pandemic, many intergenerational design teams were forced to pivot to online sessions and had to rely heavily on technology tools to facilitate these sessions. This thesis examines the technology tools used in two intergenerational participatory design teams and explores how these tools affect design participants (both children and adults) to execute participatory design techniques to their full potential. Through exploratory analysis of data collected from four sources (observation of participatory design sessions, participatory design sessions' artifacts, semi-structured interviews with adult participants, and expert interviews), this thesis reports on three themes that emerged on how technology tools impact online intergenerational collaboration: 1) social ability online, 2) technical challenges, and 3) power dynamics in online participatory design sessions. To mitigate the barriers caused by technology tools, recommendations on the participatory design processes as well as design of technology tools used in online participatory design work are discussed, with the aspirational

goal of achieving equal partnership in the intergenerational design process. The findings of this research would ultimately encourage further meaningful collaboration in online synchronous design teams of all ages.

EXAMINING TECHNOLOGY TOOLS USED IN ONLINE INTERGENERATIONAL PARTICIPATORY DESIGN TEAMS

by

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Chapter 1: Introduction

For the past two decades, as technology became more pervasive and as our society becomes more diverse, children have been seen as essential users of technology (Fulton, 1998). Methods such as cooperative inquiry (Druin, 1999) has been used to build partnerships with children and obtain their thoughts and ideas in developing technology for and with children. Druin developed a framework of four main roles that children can play in the technology design process: user, tester, informant, and design partner (Druin, 2001). When children assume the role of design partners, they are considered equal stakeholders and they provide their viewpoints in the design of new technologies. In the work by Walsh et al. (2013), cooperative inquiry is considered as a larger design philosophy, while participatory design process. Additionally, collaborative Design, or co-design, is described as the subset of participatory design in which users become involved in the design process instead of merely testing a system or providing feedback at the end of the process. As participatory design covers a broader scope of end-users' roles, I choose to use this term hereinafter in this thesis unless the cited works or quotes use another.

Researchers have explored the concept of "equal partnership" in participatory design between adult and child designers (Yip et al., 2017). They created a framework that examines the interactions between children and adults based on prior literature and defined four dimensions that span from unbalanced to balanced interactions: facilitation, relationship building, design-by-doing, and elaboration. According to Yip et al (2017), adult-children interactions along each dimension can range from unbalanced to balanced in the same participatory design session due to many factors, such as group dynamics, people, and time. However, these four dimensions were developed within the context of in-person participatory design. In the recent years, many design teams had to pivot to online participatory design sessions (because of the COVID-19 pandemic) and had to rely heavily on technology tools to facilitate these sessions online. While this pivot was necessary, this online participatory design sessions have illuminated multiple advantages including children being able to participate in participatory design sessions from the comfort of their home. Thus, online participatory design sessions are here to stay, and it is important to understand how these four dimensions are positioned in online participatory design sessions.

1.1 Motivation

Walsh et al. (2013) presented a framework of commonly used design techniques for participatory design with children. Existing design techniques were developed in the inperson design process, and have been modified for online participatory design sessions. Technology tools and platforms have been adapted to execute participatory design techniques. While benefits of online participatory design sessions are recognized (such as allowing broader participation), according to J. Fails et al. (2022), tensions and variability in power dynamics are more pronounced in online settings than in in-person sessions. In some cases, when technology issues arise (e.g., connectivity, interaction challenges, etc.), the balance of power is skewed toward the adults. Technical issues required adults to take on more traditional adult-child power relations and act as guides and facilitators. Thus, it is important to understand how the technology tools are used to execute participatory design techniques, and what features are missing in these technology tools that suppress the use of participatory design techniques to their full potential.

1.2 <u>Research Questions</u>

In this study, I collaborate with two intergenerational participatory design teams, KidsTeam at the University of Maryland (KidsTeam UMD) and KidsTeam at the University of Washington (KidsTeam UW). Both KidsTeams have adult and child design partners and follow Druin's cooperative inquiry model in their participatory design sessions (Druin, 1999). The goal of this study is to examine the technology tools used in online synchronous participatory design, and how they affect the power dynamics in different participatory design settings. In this work, online synchronous participatory design includes *fully online* sessions and *hybrid* sessions. A hybrid session means some design partners meet face-to-face and locally join the session, while others participate in the session online via the video conferencing platform. This study is guided by the following research questions:

- How do technology tools used in online synchronous participatory design sessions with children affect intergenerational collaboration and the achievement of participatory design goals?
- 2. How do technology tools allow participatory design participants (both children and adults) to execute participatory design techniques to their full potential, or suppress participatory design activities?
- 3. How do the current technology tools affect the power dynamics between adults and children in online participatory design sessions, in comparison with the power dynamics in in-person participatory design sessions?

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1.3 Positionality Statement

It is important to make clear that the lens I bring to this study, which are as follows: my own interests and knowledge in designing technology with children (obtained through two graduate courses that I took at the UMD – Design Thinking with and for Youth and Inclusive Design), my previous observations of KidsTeam UMD sessions, my training in the field of Human-Computer Interaction at UMD, and my experience in conducting user experience research in the industry. My interest in youth learning and technology traces back to a project in education when I worked as a User Experience Research consultant in Taiwan. In that project, the research goal was to investigate how to deliver an inclusive learning experience with technology that met the unique needs of different students. I conducted exploratory research in elementary schools and learned how students interacted with technology as well as how we achieved educational equality nationwide. The project sparked my interest in exploring the role of technology in contexts with youth. Additionally, I learned the concept of participatory design and practiced this technique in an Inclusive Design course offered by the HCIM program at the University of Maryland. I was particularly interested in creating inclusive technology for children and involving children in the design processes, which motivated me to start participating in KidsTeam UMD. While engaging in the participatory design sessions and working with children in KidsTeam, I started framing the research questions for this study. At the beginning of this study, I worked with Dr. Subramaniam and other UMD iSchool faculty who have been working with children and formulated my research questions. It's worth noting that the perspectives I bring to this study are obtained from my role as a participatory design participant as well as an observer in the intergenerational design teams. In this study, therefore, I would reflect on my experiences as a design participant and my observation as a researcher. In the data collection and data analysis phases, I applied my knowledge and skills that I have obtained from my HCIM

degree training and experiences as a qualitative researcher in the industry. All of the abovementioned experiences, knowledge, and support influenced the framing, analysis, and trajectory of this work.

1.4 Contributions

This thesis examines technology tools used in intergenerational participatory design in online environments. The findings presented in this work makes contribution to the processes of participatory design with children, as well as the broader area of design work with all ages where synchronous online collaboration is needed. I identify three themes with respect to how technology tools impact collaboration with children online and the power dynamics between participatory design partners. It's worth noting that some of the observations that my study has revealed can also shed light on how we can design better technologies to reinforce online collaboration for wider technology users, not just children. Additionally, design implications and recommendations are discussed in this work in the hope that we can mitigate the hurdles caused by technology in the intergenerational design process.

1.5 Overview

This thesis is structured into the following five chapters. Chapter 2 covers related work that outlines the gaps in existing studies in online participatory design with children. Following the literature review, chapter 3 summarizes the data collection methods and the thematic analysis process used in this study. In chapter 4, I present my findings with three themes – social ability, technical challenges, and power dynamics in online participatory

design. Chapter 5 explores the design implications of online participatory design with children, limitations, and future work. Lastly, chapter 5.5 concludes the study by summarizing the key learnings discovered in my study on intergenerational participatory design.

Chapter 2: Related Work

When considering online participatory design with children, the ideal roles children and adults can play in the design process and the design techniques must be discussed. In this chapter, I review past research with respect to children's roles in designing technologies, existing participatory design techniques, and participatory design executed in different settings. These research works have inspired me to determine the gaps that my study will attempt to fill.

2.1 Children's roles in participatory design

Druin (1999) popularized the cooperative inquiry method as a philosophy to design technologies for and with children. This method has been used in the intergenerational participatory design process over the past two decades. Cooperative inquiry advocates children's roles and perspectives in design and the importance of children as active partners, using low-tech prototyping techniques to design. Later, Druin defined a framework of four roles that children can play in the technology design process: user, tester, informant, and design partner (Druin, 2001). The spectrum of children's roles spans from minimally engaged in the design process as users to fully involved as design partners. In an ideal state of intergenerational participatory design, children should be seen as design partners and have equal powers. Researchers further identified four corresponding roles that adults take on when designing technologies with children (Yip et al., 2017): 1) user-observer, 2) tester-test facilitator, 3) informant-interpreter, and 4) design partner-design partner. In their work, Yip et al. presented a framework that investigates four dimensions of adult-child interactions that span from unbalanced to balanced interactions: 1) facilitation, 2) relationship building, 3) design-by-doing, and 4) elaboration. Past research stated that the most important goal of any intergenerational design partnership is idea elaboration (M. L. Guha, 2013). In Yip's work, the elaboration dimension defines that a balanced partnership occurs when adults and children work together to elaborate and mix ideas together, whereas unbalanced interaction happens when only one side of design stakeholders tell what they want in the process. The facilitation dimension spans from balanced partnership when adults and children facilitate together, and unbalanced partnership when only adults facilitate the design session. The design-by-doing dimension examines whether adults and children engage together, or adults just observe children designing. Additionally, the relationship building dimension investigates how much social interaction can be observed in the intergenerational design group. This dimension spans from adults being socially distant from children to the establishment of closer relationships between adults and children. This adult-child interaction framework has inspired how I design this study and the key components that I observed in the intergenerational design sessions.

Another relevant work regarding children's role in designing technologies (Schepers et al., 2017) explored the genuine forms of participation in adult-child collaboration, stating that genuine participation should generate knowledge in children, enable children's voices to be heard, impact decision-making, and empower them. This research further introduced a play perspective and incorporated it into the participatory design workshop. They described play as an approach to avoid adults being seen as authority figures by child design partners. Additionally, they proposed the concept of children as process designers that allows children to co-define the process and the methods used in design and enables genuine forms of participation. The idea of genuine participation inspired this study to explore true collaboration between design stakeholders in online intergenerational design teams.

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2.2 Existing participatory design techniques

To examine technology tools used in online participatory design, it's necessary to understand the design techniques that are used in in-person participatory design with children and what techniques are carried out in online design sessions. Researchers have developed design techniques to foster a more balanced partnership between adults and children (Dindler et al., 2005; J. A. Fails et al., 2013; Giaccardi et al., 2012; M. Guha et al., 2004; Moraveji et al., 2007; Walsh et al., 2010). Fails et al. (2013) differentiated the terms *technique* and *method* with respect to designing technology. The term *technique* is described narrowly as an activity that a design team participates in while creating a technology. Walsh et al. (2013) define a technique as "a creative endeavor that is meant to communicate design ideas and system requirements to a larger group", whereas a method is "a collection of techniques used in conjunction with a larger design philosophy". Cooperative inquiry is one of the most commonly used methods when designing technologies with children.

Fails et al. (2013) discussed a typical design process and the goals for each step including defining a problem, researching a problem, creating multiple solutions, evaluating solutions, and iterating the design. Design techniques are executed to achieve the goals and involve children in the technology design process. Researchers have developed a comprehensive guide in regard to the design techniques and their relation to the general design goals (J. A. Fails et al., 2013). In their work, they describe how to perform the techniques, the materials needed, and the best practices for executing each technique that involve children in the design process. In KidsTeam, the techniques that are frequently used in online intergenerational design activities include *sticky notes, layered elaboration , large group discussions using whiteboard*, etc. According to Fails et al. (2013), the sticky notes technique is a part of Cooperative Inquiry where children and adults work together and

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critique an existing technology or prototype. Ideas or observations are written on sticky notes (e.g., Post-it notes). In a design session, sticky notes are collected and similar ideas are grouped as patterns emerge. Layered elaboration is used for brainstorming multiple solutions and allows design partners to elaborate on others' ideas without "ruining" the initial idea, which child design partners may be cautious about. At the end of a participatory design session, the large group discussion technique is typically used to discuss individual or small group's ideas. Through the process, design partners can see where ideas overlap and the areas of concern for a technology. The best practices presented by Fails et al. (2013) not only provide helpful context for standard ways to implement the design techniques but also help designers understand what are the primary design goals that each technique aims to achieve.

A framework of commonly used design techniques for participatory design with children sets out eight dimensions to classify design techniques (Walsh et al. 2013). The framework covers three aspects, including the design partners, the design goal, and the design technique. The eight dimensions presented in this work include: 1) partner experience, 2) need for accommodation, 3) design space, 4) maturity of the design, 5) cost, 6) portability, 7) technology level, and 8) physical interaction. This framework aims to provide insights into choosing appropriate techniques or creating effective new techniques when collaborating with children in the technology design process. While examining technology tools used in online intergenerational design, the design techniques chosen to execute online are worth considering. These eight dimensions serve as a great foundation for informing what works better in online participatory design. For example, the portability of the techniques is defined as the physical mobility of the technique or the mobility of the artifacts generated by this technique are generally difficult to move around, whereas *Sticky noting* is defined as a highly portable technique. However, this framework was developed through an

examination of past works within the context of in-person participatory design with children. While intergenerational participatory design pivoted to online, more aspects needed to be considered. For example, the accessibility of physical materials, the difficulties in digitalizing artifacts, and the challenges of demonstrating design in an online session all affect how we execute participatory design techniques, and technology tools play important roles when we consider what techniques to choose in online participatory design with children.

Building upon past studies, I want to further explore the roles of technology tools in online participatory design, how we use the tools to implement participatory design techniques with children, and what suppresses design partners to execute these design techniques to their full potential. I incorporate these aspects into the research questions I outline in this study.

2.3 Distributed participatory design

There have been studies pointing towards a variety of ways in which people collaborate in the design process. Almost all of the existing techniques we used to design with children were initially designed for co-located and synchronous participatory design. However, face-to-face participatory design with child and adult design partners is not always possible due to differences in geographical location or time (Walsh, 2011). Previous works on distributed cooperation help us understand how people collaborate in different settings (Danielsson et al., 2008; Rodden & Blair, 1991; Walsh, 2011). Rodden & Blair (1991) stated that people cooperate in different ways depending on a variety of circumstances and thus highlighted three forms of cooperation: synchronous (cooperation happens at the same time), asynchronous (cooperation happens at different times), and mixed (a combination of synchronous and asynchronous cooperation). While we were forced to migrate to online space to conduct participatory design with children during the recent COVID-19 pandemic, we have learned that distributed participatory design requires additional attention and effort in facilitation (Walsh et al., 2012). Equal partnership between child and adult design partners has been more challenging to achieve in distributed participatory design. However, many techniques and tools have been developed for this context. For instance, Walsh et al. designed DisCo, a tool that enables asynchronous participatory design with children while design partners are geographically distributed (Walsh et al., 2012). Another online tool Pdot proposed by Heintz & Govaerts (2014) targets the user interfaces of web-based applications (webapps) in distributed participatory design. Additionally, *video co-design* is a technique employed in distributed participatory design activities synchronously and are linked through videoconference. Video co-design has been a common technique in geographically distributed intergenerational design teams.

2.4 Synchronous online participatory design

A study by Lee et al. (2021) introduced a conceptual model in regard to conducting synchronous online participatory design with children. The conceptual model is composed of three main themes: 1) project logistics, 2) people and settings, and 3) people's co-design interactions. In their study, researchers define *project logistics* as the properties of the participatory design session that have an influence on which design techniques and tools are used for synchronous online design sessions, *people and settings* as the external factors that occur in multiple locations such as technology infrastructure, and *people's co-design interactions* as the specific engagements that happen when adult and child design partners meet synchronously online. These three themes inform the essential aspects that this study wants to address and help shed light on the study procedure and the observation protocols

used in this thesis. The *project logistics* includes two subthemes: 1) the *techniques* needed to conduct a synchronous online participatory design session, and 2) the *digital tools* that make online synchronous participatory design possible. Researchers stated that the technology tools we employ in online participatory design support adult and child design partners in four interactions: meet, design, share, and collaborate. A single technology tool does not always support all four online interactions. Hence, a combination of digital tools might be necessary to conduct an online intergenerational participatory design session. This conceptual model has guided me through framing my research scope and inspired me to focus on the technology tools used in synchronous participatory design sessions.

2.5 Summary

Building upon previous research, this thesis aims to explore the technology tools used in online synchronous participatory design. A recent work presents three case studies from three intergenerational participatory design teams (KidsTeam UMD, KidsTeam UW, and KidsTeam Boise) that have been conducting participatory design sessions during the COVID-19 pandemic (J. Fails et al., 2022). Each team presents perspectives with respect to the transition to online participatory design during the pandemic; the logistics and design tools in online sessions; and advances, challenges, and surprises that came along with the transition. The collective reflections across three teams indicated that tensions in adult-child power dynamics are more pronounced in online participatory design than in in-person settings. When technology issues occur, the partnership is imbalanced and skewed toward the adults. The roles of adult and child design partners in participatory design have shifted due to technical challenges.

Researchers stated that the future of participatory design post-COVID-19 can push the boundaries of traditional participatory design by considering four dimensions: scalability/intimacy, technological influence, freedom and autonomy, and physicality in codesign (J. Fails et al., 2022). One intriguing question proposed in the discussion was "*how do we conceptualize the changing roles that children play in technology design when our interactions are mediated through yet another layer of technology (i.e., remote presence)?*"

(J. Fails et al., 2022, p. 19) With the knowledge of the current practice of participatory design with children online, and the gaps presented within, I was motivated to examine the technology tools we use in online synchronous participatory design sessions. Additionally, I aim to uncover how the technology tools affect the power dynamics between adult and child design partners, and how we can design a technology platform that helps reinforce equal partnership and balanced power dynamics that we experience in in-person participatory design sessions.

Chapter 3: Research Design

3.1 Background

With the knowledge of participatory design techniques, my own experience in intergenerational participatory design sessions, and the gaps presented within different formats of participatory design activities identified in the literature, I was motivated to design this study to examine the technologies used in online intergenerational participatory design teams and answer the research questions that I have posed in chapter 1. In this study, I collaborate with two intergenerational participatory design teams, KidsTeam at the University of Maryland (KidsTeam UMD) and KidsTeam at the University of Washington (KidsTeam UW). As intergenerational teams, KidsTeam UMD and KidsTeam UW have adult and child designers and follow Druin's cooperative inquiry model in the design of their sessions (Druin, 1999). Due to the outbreak of COVID-19 pandemic, the teams pivoted to online participatory design with children (J. Fails et al., 2022). KidsTeam UMD started synchronous online sessions in April 2020 and had been conducting both in-person sessions and online sessions since October 2021. KidsTeam UMD resumed all sessions in-person in March 2022 after the spring break. KidsTeam UW began synchronous online sessions in April 2020. In March 2022, KidsTeam UW opened on-campus in-person participation option and started hybrid sessions, where some design partners remained online and some joined locally on the University of Washington campus. Child design partners in KidsTeam UMD age range from 7 to 13 years old. Child design partners in KidsTeam UW age range from 7 to 11 years old.

The study protocol was approved by the Institutional Review Board (IRB) at the University of Maryland with the submission of amendment/modification materials for the KidsTeam UMD project. This study procedure aims to explore how technology tools are used to execute participatory design techniques and cultivate balanced and equal partnerships between adult and child design partners. My goal in designing this study was to incorporate perspectives from diverse stakeholders in participatory design with children. To obtain these diverse perspectives, my data collection included four methods:

- Observation, including my own observation and observation from adult design partners
- Participatory design sessions with two intergenerational design teams (one at UMD and one at UW)
- 3) Semi-structured interviews with adult design partners
- Expert interviews with the directors of the two intergenerational participatory design teams – an expert each from UW and UMD.

The data was collected in Spring 2022, the second semester of the 2021 academic year. Child design partners in both intergenerational design teams had been part of the KidsTeam for at least one semester. Some children had been on KidsTeam for more than one year. Thus, adult and child design partners had built rapport with each other and were familiar with the process of participatory design. The lens I bring to this study is obtained from my role as a participatory design participant as well as an observer in the intergenerational design teams. Therefore, the data collection included my experiences as an adult design partners in both design teams and my observations as a researcher. Additionally, adult design partners in both design teams were faculty members or students in the universities (UMD and UW) with academic backgrounds in information science or human-computer interaction. It is thus important to make clear that this work draws insights from participants who were relatively knowledgeable in the field of design.

3.2 Study Procedures

3.2.1 Observation

KidsTeam participatory design sessions are facilitated with a specific structure, beginning with a circle time when design partners discuss *Question of the Day* as a start, and then work in small design groups. My observation of the whole team and interaction between design partners provides an overall understanding of how technology is used in intergenerational participatory design teams and how the tools affect the interaction between design partners. However, my own observation may be limited because half of the participatory design activities are held in small design groups. Therefore, some interactions or incidents in the breakout groups might be missed. To mitigate this, I developed observation protocols (Appendix A, B, and C) for adult design partners to fill out after each KidsTeam session, to capture their observations.

Overall, I participated in twenty-two participatory design sessions, including fifteen sessions in KidsTeam UMD and seven sessions in KidsTeam UW. I observed ten online sessions, six in-person sessions, and six hybrid sessions. Hybrid participatory design means most design partners are locally present in the design space while others virtually join the session via Zoom. The technology setup for hybrid sessions varied between KidsTeam UMD and KidsTeam UW. In Spring 2022, KidsTeam UMD had one child design partner occasionally joining in-person sessions via Zoom. There was always a local adult design partner connecting the child to the design team with a laptop. In KidsTeam UW, however, more design partners virtually joined the hybrid sessions. The technology setup in KidsTeam UW included a 360-degree video conferencing camera (the owl camera) which allows online design partners to have a better view of the whole room. Additionally, when the team worked in breakout groups, three desktops at different corners of the room served as the spots for the local design participants to collaborate with online partners. Overall, the technology setup in hybrid sessions was relatively well-established in KidsTeam UW because the team wanted to continue hybrid participatory design in the future, instead of simply reverting back being exclusively in-person.

Through the observations in three different participatory design settings, I compare the execution of participatory design techniques and the power dynamics between in-person sessions and online synchronous participatory design sessions (including fully online sessions and hybrid sessions). Table 1 provides the summary of the participatory design sessions that I observed in this phase of data collection.

Table 1: Observation of KidsTeam participatory design sessions

	Online	In-person	Hybrid	Total
KidsTeam UMD	8	6	1	15
KidsTeam UW	2	0	5	7
Total	10	6	6	22

As mentioned above, I also invited three adult design partners in KidsTeam UMD and two adult design partners in KidsTeam UW to observe and collected their responses via the observation protocols. In the online participatory design observation protocol (Appendix A), adult design partners were asked to fill out three sections:

- 1) Design activities and participatory design
 - a. What worked well
 - b. What worked not well
 - c. Other thoughts
- 2) Digital tools, hardware & software

- a. What worked well
- b. What worked not well
- c. Other thoughts
- 3) Design partners' interaction
 - a. Whole group
 - b. Adult-Child Interaction
 - c. Child-Child Interaction
 - d. Adult-Adult Interaction

The protocol for in-person sessions follows a similar structure, but the second section was substituted with "In-person tools, design materials". The in-person session protocol can be found in Appendix B. The protocol for hybrid sessions includes both "Digital tools, hardware & software" and "In-person tools, design materials" and can be found in Appendix C. Although this study focuses on technology tools used in online synchronous participatory design sessions, the observation protocols for in-person sessions are collected to investigate the third research question: *how do the current technology tools affect the power dynamics between adults and children in online participatory design sessions*, in *comparison with the power dynamics in in-person participatory design sessions*? Through adults' observations of three different participatory design settings, I examine the power dynamics between in-person sessions, fully online sessions, and hybrid sessions. In this stage of data collection, I collected fourteen observation protocols - four online sessions, four in-person sessions, and six hybrid sessions. The collected responses are listed below in Table 2.

	Online	In-person	Hybrid	Total
Adult A (UMD)	0	3	0	3
Adult B (UMD)	2	0	0	2
Adult C (UMD)	1	1	2	4
Adult D (UW)	1	0	2	3
Adult E (UW)	0	0	2	2
Total	4	4	6	14

Table 2: Collected observation protocols from five participants

3.2.2 Participatory design sessions

After collecting observational data, I conducted two participatory design sessions "Design for Online KidsTeam" with KidsTeam UMD and KidsTeam UW. The 90-minute participatory design sessions were held online via Zoom. The KidsTeam UMD session plan can be found in Appendix D. In the UMD session, I had six children (five boys and a girl, age range from 7 to 13), and four adults (including myself) participated in the session. I split design partners into three groups based on their age, familiarity with each other, and the designated digital tool:

- 1) Group 1: Zoom (2 boys and an adult)
- 2) Group 2: Jamboard (2 boys and an adult)
- 3) Group 3: Padlet (1 boy, 1 girl, and an adult)

The KidsTeam UW session plan can be found in Appendix E. Eight children (six boys and two girls, age range from 7 to 11) and six adults (including myself) participated in the participatory design session. Design partners were assigned to three groups and each group examined one digital tool.

- 1) Group 1: Zoom (2 girls, 1 boy, and 2 adults)
- 2) Group 2: Jamboard (2 boys and 2 adults)
- 3) Group 3: Google slides (3 boys and an adult)

My goal for the participatory design session was to examine whether there were missing features that affect the power dynamics between adults and children in online participatory design. There were two main factors regarding how I chose the tools we evaluated and redesigned in the breakout groups. First of all, the design activities started with identifying issues in current technology tools to brainstorming ideas to improve them. Given the limited time to facilitate discussion and the amount of information I would like to gather from the session, asking design partners to work with current digital tools, instead of introducing new tools would be more efficient to achieve my goal for the session. Second, I believe design partners could generate more design ideas in the brainstorming activities if we worked with the tools that they used often in their recent and current participatory design activities. The Design for Online KidsTeam participatory design sessions consisted of three main activities:

1. Circle time / Question of the day

I briefly introduced the purpose of Design for Online KidsTeam session to design partners and then moved on to the Question of the Day. Question of the Day during snack time served as a transition to design activities and built rapport between design partners. The question was, "What is your favorite online tool that we have used and why? What is your least favorite?" I used large group discussion technique (J. A. Fails et al., 2013) and the Zoom whiteboard feature to facilitate the discussion. Design partners took turns answering the question, and to my surprise, children came up with answers out of the scope of my definition of "digital tools in KidsTeam session", namely Zoom, Jamboard, Padlet, and Google Slides.

Children conceptualized the question and defined the technology tools in different ways.

Figure 1: Session slides during Circle Time and Question of the Day



Question of the Day

What is your favorite online tool that we have used and why? What is your least favorite?

We have used zoom, jamboard, google slides padlet.

2. Likes and dislikes of the tool

During this first design activity, I assigned design partners in groups and asked them to brainstorm the likes and dislikes of the technology tools: Zoom, Jamboard, Padlet, and Google Slides. It was worth noting that each group used the designated tool to jot down their thoughts, meaning the Zoom group used Zoom to write down their thoughts, the Jamboard group used Jamboard to write down their thoughts, etc. The purpose was to create the context for design partners so that they could examine the pros and cons of the tools while actively using them. I initially asked participants to use sticky notes technique (J. A. Fails et al., 2013) to write down their thoughts, green sticky notes for likes and pink sticky notes for dislikes, but then realized there were no sticky notes feature on Zoom whiteboard and Padlet. Therefore, the Zoom and Padlet groups used whichever was accessible to write down their ideas.

Figure 2: Session slides during Design Activity

Design Activity

Part One (15 mins): Write down the **likes** and **dislikes** of the tool. Pick top two of likes and dislikes.

Part two (25 mins): Brainstorm **design ideas** to fix the dislikes of the tools! The goal is to fix as many dislikes as you can.

3. Design ideas

After brainstorming likes and dislikes, I asked design partners to use different colors of sticky notes, or text colors, to brainstorm design ideas that we could improve in the current tools, or design new features to fulfill the needs of online KidsTeam. I specifically told the design partners, "our goal is to solve as many dislikes of the technology as we can!" The groups came up with design ideas for different technology tools, but similar patterns were observed in those ideas and are presented in chapter 5. I initially hoped we would have enough time to let design partners rotate through tools, but it turned out that each team only had time to work on one technology tool.

3.2.3 Semi-structured interviews with adult design partners

After collecting observational data from adult design partners, I conducted follow-up interviews with five adult design partners to gain in-depth understanding of the observation protocols collected in table 2. The KidsTeam Adult Interview Protocol can be found in Appendix F. The one-on-one interviews were held virtually on Zoom. Each semi-structured interview lasted 60 minutes and the interview questions were structured within the sections listed below:

- 1) Introduction
- 2) Warm-up
- 3) KidsTeam general questions
- 4) Online/hybrid/in-person participatory design
- 5) Digital tools
- 6) Wrap-up

3.2.4 Expert Interviews

In addition to the in-depth interviews with adult design partners, I conducted two expert interviews with the director of KidsTeam UMD and the director of KidsTeam UW. Both experts have had more than ten years of experience in participatory design with children. The goal of the expert interviews was to learn how they operate intergenerational design teams, how experts perceive and compare different formats of participatory design sessions (online/in-person/hybrid) as well as the challenges and advantages of different formats of participatory design sessions. Some of the important questions included:

- What are the challenges and advantages of online participatory design sessions? What about in-person and hybrid sessions?
- In terms of design partners' interaction, what do you think are the differences between online and in-person participatory design sessions?
- To achieve the goals in participatory design with children, what are the missing aspects/features/elements in the technologies that we have been using in online KidsTeam?
- What could be improved in the current online participatory design settings?

3.3 Data Analysis

All of the interviews were recorded. I used automatic transcription software otter.ai to generate seven interview transcriptions, including five adult design partner interviews and two expert interviews., I listened to the recordings and read through each transcription, and then started coding the scripts sentence-by-sentence with the thematic coding technique. At this point, I also included data collected from observation protocols. I referenced and followed a thematic analysis approach proposed by Braun and Clarke (Braun & Clarke, 2006). In this study, thematic analysis was performed inductively. I initially coded interview data from UMD participants and formed emergent themes. After the first pass in UMD interview sessions, I analyzed interview data from UW participants into the existing themes. In the meantime, I also reviewed themes and added new categories to the codebook. After I

completed analyzing all interview data, I reviewed and refined them. The themes from the interviews are outlined in Chapter 4 Findings.

The artifacts and results from two participatory design sessions served as an approach to gather children's perspectives in regard to how they perceive technologies used in KidsTeam online design sessions and how they would like to redesign and improve these tools. I incorporate this portion of insights in Chapter 5 Discussion. Due to the limited time in data collection, conducting participatory design sessions is a more efficient approach to learn from children's perspectives than one-on-one interviews with children. Additionally, this study aims to examine how technology tools affect intergenerational collaboration, the achievement of participatory design goals, and the execution of participatory design techniques. This requires the ability to reflect retrospectively. With the time restriction, therefore, one-on-one interviews with adults would help draw more insights than interviews with children.

Chapter 4: Findings

In online participatory design, I learned that there are two main components critical to one's experience — technology tools and participatory design techniques. To improve our collaboration and experience in online intergenerational participatory design activities, we would have to take both aspects into account. Figure 3 illustrates how I perceive the relationship between these two components. In online participatory design sessions, participatory design techniques are embedded in the technology tools we have access to. With the affordances and limitations of technology, KidsTeams chose the techniques that they were able to implement online when their sessions were forced to migrate to online due to the pandemic. Technology tools and participatory design techniques are interconnected and form how we experience online participatory design sessions. I believe that some of the participatory design techniques, which were initially developed for in-person settings but then applied in online space, are not the perfect solutions and that new or improved participatory design techniques are worth exploring in future work. In this study, however, I focus more on
the aspect of technology tools. The findings presented in this chapter aim to answer the following research questions:

- How do technology tools used in online synchronous participatory design sessions with children affect intergenerational collaboration and the achievement of participatory design goals?
- 2. How do technology tools allow participatory design participants (both children and adults) to execute participatory design techniques to their full potential, or suppress participatory design activities?
- 3. How do the current technology tools affect the power dynamics between adults and children in online participatory design sessions, in comparison with the power dynamics in in-person participatory design sessions?

Figure 3: Technology tools and participatory design techniques



To further explore technology tools and answer the research questions, three themes are identified in this study:

- 1) Social ability online
- 2) Technical challenges
- 3) Power dynamics in online participatory design

The relation between these three themes is illustrated in Figure 4. In this study, I found that social ability online and the technical challenges encountered in online participatory design are affecting the power dynamics (child-adult, child-child, adult-adult) in the intergenerational participatory design teams. An overview of the themes and descriptions is provided in Table 3.

Figure 4: The relation between the identified themes



Online Intergenerational Participatory Design

Theme	Description	Subthemes
4.1 Social ability online	How technology tools affect the ways we collaborate online and implement participatory design techniques.	4.1.1 Affordances and features of Zoom limit our social ability online
		4.1.2 Lack of one-on-one interaction
		4.1.3 Limited breakout room interaction
		4.1.4 Adult-prompting conversation
		4.1.5 Disconnect in hybrid settings
		4.1.6 Lack of embodied experiences altogether
4.2 Technical challenges	The technical challenges we experience with children and how they suppress participatory design activities.	4.2.1 Technology infrastructure
		4.2.2 Difficulties in offering individualized support and troubleshooting with children
		4.2.3 Technology learning curve
		4.2.4 Design freely with technology online
4.3 Power dynamics in online participatory design	The power dynamics between design partners in online participatory design sessions.	4.3.1 Child–adult interaction
		4.3.2 Child–child interaction
		4.3.3 Adult–adult interaction
		4.3.4 True collaboration

Table 3: Findings overview and descriptions of the themes

4.1 Social ability online

Research Question 1: How do technology tools used in online synchronous participatory design sessions with children affect intergenerational collaboration and the achievement of participatory design goals?

This theme emerged as an answer to the first research question. I conducted observation and interviews in online participatory design sessions, as well as in in-person and hybrid sessions in order to gain a holistic understanding of how the intergenerational teams collaborate in different settings and compare the differences in between. From the interviews with the directors of two intergenerational design teams, I learned that an important participatory design goal they would consider was how to provide a diverse, inclusive, and equitable environment for design partners. Involving technology tools in the design process promoted intergenerational collaboration. For example, previously parents take children to the university campus to participate in KidsTeam design activities. With the addition of technologies (e.g., video conferencing tool), KidsTeam could involve children with diverse backgrounds in the design team that eliminates the transportation issue. While technologies have brought us benefits, some downsides have been affecting intergenerational collaboration in online participatory design. For example, the affordances and features of the video conferencing tool Zoom were salient discussions that emerged during my interviews with adult design partners and experts. To work with children safely online, KidsTeam needed to use a secure and university-approved tool. Due to the limited affordances and features offered by Zoom, all design partners mentioned that Zoom suppressed their communication and collaboration online.

"Zoom is almost perfect for a classroom, but harder for co-design with children." [Expert 1]

"We're inviting the kids into our online space. This space we're using is an adult space. We're using a tool that adults created for adults to meet online." [Adult 2]

The video conferencing tool used in online participatory design does not afford oneon-one interaction and different communication styles. The affordances of the video conferencing tool take design partners more effort to speak up in design activities and thus affect how design partners implement participatory design techniques in online participatory design sessions. I further examine our social ability in online participatory design and develop six subthemes as outlined below. 4.1.1 Affordances and features of Zoom limit our social ability online

"There's still this hesitancy to really engage online because there's an additional barrier of being online." [Expert 2]

"Zoom mute/unmute feature kills a lot of the background noise we have in-person, but also makes it difficult to read cues" [Adult 1, UMD]

I investigated the affordances and features on Zoom and found that some features create barriers that limit design partners' abilities to speak up whenever they would like to. The features are listed below.

- Mute and unmute button
- Turn the camera on and off
- Raise hand button
- Group chat feature

During an online session, participatory design participants are on mute for the most part and children have the freedom to turn off their cameras. It has become a social norm that everyone would mute themselves to prevent cacophony from various physical spaces. This online social norm also creates a series of actions that design partners need to take before sharing their thoughts. For example, when a person has an idea and wants to share it with the group, the actions might include 1) find the right moment to join the conversation, 2) raise hand and wait to be called on, 3) unmute, and 4) speak. One adult shared that in online sessions, children who speak up most are generally more willing to intervene in a conversation or have the nicest technology that always works. Communication in online participatory design becomes more difficult and rigid because it takes design partners more effort to speak and the interaction is not as natural as what we would do in in-person participatory design where people are more comfortable sharing thoughts and bouncing ideas. In this sense, it's been harder to implement some participatory design techniques in online sessions. For example, layered elaboration technique is used for brainstorming multiple solutions. According to Fails et al. (2013), the elaboration process involves changing, extending, adding to, and subtracting from the ideas of others. It would be easier to elaborate on other's ideas in in-person participatory design sessions because children and adults would feel they are closer with each other and children become more comfortable speaking up.

4.1.2 Lack of one-on-one interaction

"Talking in a virtual environment means talking over someone because essentially you don't have your own space or distance from other people." [Adult 3, UMD]

"It's difficult to engage with one kid at a time due to equal proximity of all kids. When in-person, you can just move to another part of the room." [Adult 1, UMD]

"When we are in person, they're spread across the room, and you can go for a minute and sit next to one of the kids while others are doing whatever they're doing." [Adult 4, UW]

Based on the observations and interviews with adult design partners, I learned that the equal distance between all design partners in a big Zoom room makes it hard to interact with every individual. Children sometimes have specific needs and questions or need support. Unlike in-person interaction where an adult can move a child to another side, participants cannot have a side conversation on Zoom. If adult designers want to engage with one child at a time, the Zoom breakout room would be the only solution but not an ideal one. Otherwise, the conversation would need to be heard by the whole group and other participants would be waiting for that discussion to end and to return to the main activity. Additionally, children have their ups and downs in terms of their enthusiasm to participate, but this limitation also affects adults' abilities to offer emotional support to the children. An adult shared, "you're mainly ignoring their needs because you can't really do anything. You can't spend time taking the kids to the side and talking about what's bothering them." In in-person participatory design, adults can come to children and ask one of them questions about specific things, and that will resolve the issue that they are experiencing. It's more natural to physically move the children around and offer questions and design observations on something children can work on or something they may be interested in doing.

4.1.3 Limited breakout room interaction

"You are not able to be in and out of conversations in a way that you can be in a whole group and in a breakout room at the same time." [Adult 1, UMD]

"How do I actually get in touch with the other people outside the breakout room if I need to talk to someone?" [Expert 2]

In each KidsTeam session, design partners are usually assigned into groups and move to breakout rooms to work on design activities. However, four adult designers indicate the main issue with the breakout room feature in online participatory design sessions is that design partners are not able to read the whole room or to be in and out of conversations. In the interview with Adult 1, she made a metaphor for breakout rooms — "going into the breakout room with a kid is like being separated in a physical room. You shut the door, and you no longer know what is happening in the whole group." The affordance of the breakout room makes it hard to feel connected with the whole team. Additionally, breakout rooms limit how the facilitators (adults) communicate with each other across small design groups. Oftentimes, adults may need clues or guidance on what other groups are working on and redirect their design activities, but they are not able to get in touch and read the room on Zoom.

In in-person sessions, however, the design groups are distributed in different parts of the room and everyone is still able to overhear things happening in the environment. Additionally, design partners have more flexibility to zoom in and zoom out of the groups without losing the cue that there are other people out there and knowing what's going on in the rest of the room. Through my observations in in-person sessions, children are very interested in seeing what the other groups are working on and how much progress they make, and they also like to walk around and talk to each other. Therefore, having the ability and flexibility to move in between groups and engage with each other is important for both adults and children. "When we're online, I usually ask kids something and I need to really call on them individually to get kids to have more equal participation because asking a general question to a group online wasn't the most effective." [Adult 5, UW]

"A lot of the times you are forced as an adult to manage the discussion and ask questions directly to the kids. It's not a natural situation for kids, because kids sometimes will want to work alone." [Adult 3, UMD]

Three adult design partners discuss how they facilitate the group conversation and prompt children individually in online participatory design. Through my observation with online KidsTeam and in-person KidsTeam, I learned that adult design partners have to play a more nuanced role as facilitators or leaders in online group discussions. Children are more open to spontaneously answering in in-person sessions. Being able to talk face-to-face also helps establish relationships and collaborate with each other. From the interviews with adults, the key reason for the adult needing to prompt conversations is still the affordances on Zoom as mentioned in section 4.1.1, such as the mute/unmute button, and the effort that participatory design participants need to make to speak up. In this environment, adultprompting dynamics would be, an adult asks a question and everyone waits for a person to respond. If no one unmutes and shares ideas, then the adult would have to call on children individually and children take turns to share their thoughts. As the sessions progresses through a semester, the interaction turns out to be a norm that adults bring up a topic as outlined in the session plan and direct the conversation to a specific person because they have learned that asking a general question to the group is not very effective, especially when some design participants turn their cameras off and thus feel far from each other. Adultprompting conversations skew the power dynamics towards the adult side. However, it is not

an ideal practice in intergenerational participatory design teams because we expect equal partnerships between design partners. The power dynamics in online KidsTeam will be discussed more in *4.3 Power dynamics in online participatory design*.

4.1.5 Disconnect in hybrid settings

"I'm still figuring out trying to let the kids in-person know that there are people online. A lot of the online folks are kind of just watching for the most part, and waiting until they are called on" [Adult 5, UW]

"When we're hybrid, the constraints of Zoom do stunt the online kid's ability to socialize and collaborate with others" [Adult 3, UMD]

In this study, I observed six hybrid participatory design sessions and collected six hybrid-setting observation protocols. I learn that the social patterns and dynamics in hybrid settings are interestingly very different from fully online sessions. One of the most challenging parts is to let local children acknowledge online partners' presence and collaborate with peers online. In hybrid settings, design partners are situated in different environments, locally in the design lab together or in online spaces. For in-person children, it's natural that local bonds are much stronger because online design partners are in a Zoom box on the computer, whereas things are happening in the physical space and there are many people they can talk to. Hence, there is a disconnect between online and in-person design partners. Additionally, it takes more effort for children to initiate conversations with children on the other modality (online to local or local to online), and it is naturally easier for children in the same environment to work together. One adult design partner mentioned that she had to do the same with prompting online children in a hybrid session. Otherwise, the in-person children would be dominating the conversation and not remember online participants who want to say something or may not even acknowledge their presence. It has become more challenging to get children online to have as equal participation as in-person sessions.

When I remotely joined and observed in KidsTeam UW hybrid sessions, I was the person online and I felt it was hard to build relationships with local design partners. The children on Zoom and myself were trying to understand what was happening in the design lab and we were silent for the most part. During the interviews with UW adult design partners, I realized that many things were happening in the group that I was part of, but I was not aware. For example, the session facilitator passed sticky notes from group to group to implement layered elaboration but the activity was not on camera. It's hard to show online design partners the physical materials and information and context in the whole room is lost. Being online, I as a design partner felt left out in group collaboration.

When designing a hybrid participatory design session, one of the experts suggested that the online design partners need to have certain roles that the in-person design partners depend on a little bit. For example, there was an inspiring session when local children designed mazes as circuits and online children remotely controlled robots to drive through the circuit. Although there were still some technical difficulties such as the online partners could not clearly see the whole circuit, the activities did reinforce collaboration between online and in-person.

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"When we're on zoom, KidsTeam is just a tiny little box on their computer. But inperson, they're focusing on KidsTeam and they're all around KidsTeam." [Adult 4, UW]

"It's a little bit harder online when a child decides to turn off the camera if they get distracted because they're playing a game." [Expert 1]

"Zoom is within the window of your computer screen, once we prompt kids to go to a different website, they might have that over layered on top of zoom. They're not thinking about the presence of other people there." [Expert 1]

Children have options to turn off their cameras but this makes online collaboration harder. During the interviews, one of the adults shared that when children turned their zoom cameras and microphones off in the breakout room, she had no idea if they were working on the design, doing their own things or they had walked away without telling her. Adult design partners sometimes feel isolated because they have no clue what has been happening behind the screens and it has been harder to design with children in this way. Children don't talk too much in online sessions, especially in the breakout room. An adult said she would try to prompt children to share their screens because that's the only way to know what they are actually doing. However, if an adult works with more than one child in the breakout room, adults still can't see what everyone is doing at the same time even if the children are willing to share their screens.

Additionally, online distraction and mixed contexts contribute to the feeling of lack of embodied experience. Mixed context means participatory design participants have online

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presence in design activities, but also have their whole life going on in their own physical environments (such as their home). Four interview participants indicated that it's easier to get distracted in online participatory design sessions. Distraction in online design sessions includes: 1) online space distraction such as playing games and doing homework, and 2) physical space distraction, such as family distraction or anything happening in their physical location. When children's attention is not in the entire session, the participation in online participatory design is fragmented and not the same as having embodied experiences altogether.

4.2 Technical challenges

Research Question 2: How do technology tools allow participatory design participants (both children and adults) to execute participatory design techniques to their full potential, or suppress participatory design activities?

This theme uncovers how the technology tools halt or suppress the execution of the participatory design techniques. The topic of technical challenges in online participatory design is a salient theme in this study. Technical issues in intergenerational participatory design teams include technology infrastructure, accessibility to technology, stability of devices and digital tools, learning curves of adopting new technology, etc. When designing with children, we would have to be aware that every child has different technology resources at home, different experiences and skills with technology, and their own preferences for working with technology. For adult design partners, the most challenging part is to respond to each child's specific questions when the technology does not work well. Troubleshooting with children and offering support in online spaces have not been easy since adults don't have physical access to children's devices in an online participatory design session. Additionally, redirecting a conversation online is more challenging teams and develop four subthemes as summarized below.

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"You're limited by a lot of factors online. Different kids have different setups in their homes. If you're in-person, materials are very accessible to everyone and everybody has the same toolkit. The only thing that limits you is your idea." [Adult 5, UW]

"Technology Infrastructure is one of the biggest critical issues of equity in co-design with kids." [Expert 2]

Children have different levels of device setup, internet connection, and technology support at home. When KidsTeam pivoted to online at the beginning of the pandemic, some children didn't have devices to join online KidsTeam. Some of them relied on devices provided by schools but the devices blocked certain software or applications because of firewall setups. These factors in technology infrastructure have been affecting children's engagement in online participatory design sessions. There was one session when we were using an online AI application to capture a person's pictures and sounds to train the machine. Design partners had a lot of fun in this design activity, but being on Zoom and running the AI application concurrently required too much bandwidth. In the observation protocol, Adult 1 shared that she was in the breakout room with two children playing with the technology. However, one of the children had technical problems and needed help but the adult's laptop was also not functioning properly. Her laptop did not support adequate bandwidth, thus she was trying to solve her own technical problem. The breakout room activities turned out to be chaotic because the adult's laptop was frozen and she had to leave the call and joined from another device, leaving the child's all by themselves for a while. During our interview, I noticed that when children are experiencing technical difficulties, they would fixate on it and could not focus on the topic at hand. One of the adult's responsibilities is to redirect children to something understandable and the suggestions need to be something children are willing to try. It's very challenging because every child needs is different. One of the experts indicated that it's understandable that children sometimes would like to turn their cameras off, not just because they don't feel like being in front of the cameras, but because of the technology infrastructure that each individual has at home may not have sufficient bandwidth to support video.

4.2.2 Difficulties in offering individualized support and troubleshooting with children

"A lot of my time in online sessions was spent on troubleshooting. I don't have your device in front of me while you're asking me for help. So I feel like I'm losing the power as an adult to fix issues." [Adult 4, UW]

"It's hard to offer one kid individualized support when we can't look over their shoulder. And when kids are in a state of distress, they are not able to receive your help." [Adult 1, UMD]

In online participatory design sessions, it's difficult for adults to offer help and support whenever there is a technology issue or children need help with learning new tools or features. When we are online, it is difficult to offer suggestions to solve children's tech problems especially when we are in group discussions and cannot see what's going on with individual children's devices. There was one session when a child's microphone did not work, and she was yelling as hard as she could during the entire session because she had a lot to say but she could not be heard. The adult in that group felt frustrated and powerless because she didn't have the child's device at hand and could not really suggest any useful solutions. After trying to troubleshoot with the child, the adult redirected the child to type her thoughts in the Zoom chat but the child was not good at typing and did not want to try

another communication means. This was a frustrating situation for the child. Additionally, adults feel it is challenging to maintain an active design session while trying to let the children with technology issues know they are not forgotten. For adults, technical issues are troublesome, and troubleshooting with children on Zoom is arduous.

"If I were in-person with him, I would have redirected him to an activity that he finds soothing, like drawing on his journal for a little while, and come back when he feels ready to rejoin. But you can't really do that on Zoom because they'll just leave the call!" [Adult 1, UMD]

When technology did not work as expected, children got very frustrated and they would not look over this issue. Redirection in online space is not as easy as in in-person sessions. One of the UMD adults mentioned that we have more workarounds in in-person sessions because a lot of the materials didn't require the use of specific digital tools or using the tools in a particular way. However, alternatives in online participatory design are restricted.

4.2.3 Technology learning curve

"It's important to remember that in KidsTeam we have groups of kids that are not in the same developmental stage." [Adult 2, UMD]

"The learning curve of having shapes on Google Slides just made it a bit harder for them to translate their ideas for everyone to see." [Adult 5, UW]

In KidsTeam, we have child design partners age range from seven to thirteen years old. For younger children around seven years old, the learning curve of using technology limits their abilities to design. In online design activities, adults needed to teach children how we work online and how to use certain tools, but we didn't have to teach children how to draw and express their ideas with pen and paper in in-person KidsTeam. For example, there was an online session when we worked with children to design and decorate a spring-themed app on Google Slides. Google Slides was not the best tool for some children have specific ways of how they convey their ideas and design, but using a technology tool that doesn't allow them to fully translate those ideas would make the design process harder. During my observation and interviews, I have learned the importance of introducing new tools by following step-by-step activities, and ideally having more activity time to let children explore new interfaces. Creating visual references for children to follow could have helped them overcome the technology learning curves, especially for younger children.

4.2.4 Design freely with technology online

"We don't have a good tool for kids to scribble or to draw whatever they want in the online space. Kids generally don't like to make art or design things digitally" [Adult 4, UW]

"The way Zoom is structured, such as with the mute/unmute button, chat, and everything is like for adults. There's no gamification. There are no things that kids like, and the colors are boring." [Adult 2, UMD]

From my observation and interaction with the children in KidsTeam, I've observed that children always scribble and add fun pictures, gifs, etc. on digital whiteboards. They would like to have the flexibility to do whatever they want as they do in in-person design activities. In online participatory design sessions, there are two approaches the intergenerational teams could consider to let children implement their design ideas. The first approach is to let children use physical materials, like Bag of Stuff, and then show the artifacts in front of the cameras. However, translating designs digitally is challenging because younger children might need help from their family members, and there could be misinterpretation between 3D and 2D presentations. This approach also limits collaboration and interaction between design partners because everyone works on their own design. Hence, both KidsTeam UMD and KidsTeam UW did not adopt this technique in their online participatory design sessions.

Another approach is to use technology tools, such as digital whiteboards, online big papers, and collaborative spaces to brainstorm and design as a group. Most of the online participatory design sessions include brainstorming ideas with the sticky notes technique. This technique is easier to be performed online, but using sticky notes all the time does not gauge children's interests and keep their attention. Children generally have more fun doing design activities where they can implement their ideas. However, if the team wants to let children carry out their ideas visually, current tools in online participatory design sessions do not allow children's needs to freely draw, revise, and share with peers online. One of the experts indicated that the tools we have been using do not provide a very good platform that translates children's ideas so there are lots of misunderstanding. During the interview, the expert said, *"where does the physical space lie in certain things? How do we allow a child to cut, paste and draw online?"* To execute participatory design techniques in online environments, we would have to rethink how we can truly collaborate online and perform these tasks without being limited in certain ways.

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4.3 Power dynamics in online participatory design

Research Question 3: How do the current technology tools affect the power dynamics between adults and children in online participatory design sessions, in comparison with the power dynamics in in-person participatory design sessions?

The findings in the previous sections – social ability online and technical challenges impact the power dynamics in online participatory design with children. In this section, I summarize my findings into three subthemes: 1) child–adult interaction, 2) child–child interaction, and 3) adult–adult interaction. Then, I summarize power dynamics in online participatory design sessions with some questions around the topic of true collaboration.

4.3.1 Child–adult interaction

"Zoom is not just designed for adults, but designed for specific power dynamics. Inperson, you can share control more, but not online." [Expert 1]

"The power dynamics were more apparent in online sessions because we have control abilities through Zoom and tools. When you share the screen, you have to be more gentle and more aware of what kids experience on the other side." [Adult 2, UMD]

"I was perceived more like a teacher instead of a design partner when I tried prompting him to speak." [Adult 3, UMD]

Based on what has been discussed in the previous sections, I have learned that the features and affordances of Zoom limit our social ability online and that children have technology learning curves and less freedom when they design online. The power structure embedded in technology tools has resulted in the imbalanced power dynamics between adult

and child design partners. Most of the technologies we use in online participatory design are designed for adults to collaborate. During my observations in KidsTeam sessions and interviews with adults, I found that participatory design on Zoom is adult-directed. It is adult-directed because of the technological barriers. The power dynamic in online KidsTeam is thus more apparent and skewing towards the adults' side. Three adult design partners indicated that online participatory design seemed more formal. They also felt that online sessions looked like what children were doing in online schools because of all the Zoom affordances and adult-prompting interaction. Hence, the dynamic between adults and children is similar to the teacher-student dynamic. It's more challenging to reach the goal of equal partnership under the circumstances.

In online intergenerational participatory design, adults are more like facilitators who have control over technologies. Adults share screens, introduce design activities, and demonstrate how to use certain technologies. The concept of the screen sharing feature is to centralize power with one person in charge. When children want to work on their designs, they sometimes don't like that. If children are using a website or playing with an application but someone shares their screen, Zoom would take over children's entire screens and interrupt what children are working on. This results in children getting frustrated or impatient. The screen sharing feature is necessary when we want to introduce a new concept, yet adults have to be particularly aware of the impact of screen sharing on the children's experiences on their devices. Additionally, sharing power with children is important in online participatory design. There was one online session when participatory design partners were joking around screen sharing and a girl asked the session host to make her co-host. When she was granted as co-host, she made a joke by muting the host when he was speaking. It was humorous to see children take the power back in this way but this also illuminated the importance of balanced power in online participatory design. In in-person design sessions, it's easier for adults to

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share control and children have the autonomy to roam around and interact with people in any way they want. An adult shared that if she notices unequal participation in the group, it's also much more natural to include someone in the discussion when the design partners are physically present.

4.3.2 Child-child interaction

"A lot of the sessions I've been involved in, kids have been sort of generating their own parallel play." [Adult 1, UMD]

"I feel like they don't really talk to each other on Zoom and they're not asking each other questions." [Adult 4, UW]

Child-to-child interaction is limited in online participatory design. In my observation, it is worth noting that the current tools do not allow children to choose who they want to interact. For example, children cannot choose another child to sit with or play with as they normally do in in-person sessions. Being online, children talk over each other as a big group, whereas small group interactions develop naturally in in-person participatory design. Additionally, children follow what adults say in online design activities, and generally have fewer connections because it's harder to have one-on-one interaction online than in in-person sessions. There was an inspiring in-person KidsTeam session when a seven-year-old girl asked me to help her cut the cardboard. Then, another seven-year-old little boy in my group voluntarily offered help, *"I can help you! Let me try."* At that moment, I had a strong feeling about what we lost in online participatory design with children.

"You can't help each other as much as fluidly online. If I ask someone to help with something, it has to be very explicit." [Expert 1]

"Online session is harder because people fall into assigned roles." [Adult 4, UW]

"It would be great to have a feature on Zoom where adults could communicate while in breakout rooms" [Adult 3, UMD]

In KidsTeam, we usually have adult design partners assigned in different groups to work with children. Oftentimes, adults navigate around to help each other or to know how much progress every group makes so that they can adjust accordingly. However, communication between adults is more rigid on Zoom. Due to the lack of one-on-one communication, adults cannot help each other as fluently as they do in in-person sessions. People tend to fall into specific roles and the tasks need to be very explicit. For example, if there are two adults in a breakout room, the roles and tasks might be for one adult to facilitate the discussion and speak more, while another adult takes notes without speaking too much. Adult collaboration in in-person sessions would be much smoother since they can easily see when children need more assistance, and they can interact with them and ask them questions. It's common to see adults move around and take turns working with different children in person. Through the rotation, layers of ideas are built in the group. This is when we are truly implementing layered elaboration and reaching the goal of participatory design with children.

4.3.4 True collaboration

"It's been hard for me to get into a situation where I really feel like we're collaborating. It feels like more often I'm facilitating, eliciting, or providing support." [Adult 1, UMD]

"One of the big problems with a lot of these platforms is that they haven't thought about the idea that how can people truly collaborate online and do all these things in which we are limited in certain ways." [Expert 2]

In this study, an emerging topic is how we feel truly connected in online and hybrid participatory design, and what makes us collaborate seamlessly online. One of the adults shared that it feels hard to get into that ideal state of true collaboration because oftentimes, she is facilitating the discussion and providing support to children without really contributing ideas to the group. Part of the reasons is that we have been limited in certain ways that we communicate and collaborate online. Group dynamics in online collaboration are worth studying.

During the interview with one of the experts, he mentioned that it is sometimes natural that people turn off their cameras and microphones due to technological bandwidth or device setup. So, when design partners, mostly children, don't want to turn on their cameras or unmute themselves to speak up, what are the alternatives that allow us to still have good interaction? How do we still feel connected online without video and audio? Additionally, most technology tools mainly focus on the online to online collaboration. In the real world, however, we're having more hybrid collaboration. When we have part of the group online and other people physically in the same space, how do we let both sides understand where they are positioned, be able to freely jump in and out of conversations, and come back with more ideas and learnings? These are the new norms of natural collaboration online that need to be studied.

Chapter 5: Discussion and Conclusion

This thesis demonstrates the relation between technology tools and participatory design techniques, and delves deeper into the aspect of technology tools in intergenerational participatory design. The previous chapter highlights findings surrounding how the tools have impacted our social ability online. Building upon previous works related to technical challenges in online participatory design (Antle & Frauenberger, 2020; J. Fails et al., 2022; Lee et al., 2021), I pinpoint how the technical difficulties have suppressed the intergenerational teams to conduct participatory design online. In the previous chapter, I also point out that the power dynamics are more prominent between design stakeholders in online settings. The insights presented in this study could be used as a source of direction while facilitating design sessions with intergenerational design partners, or the broader area of collaboration with all ages in online environments. In this chapter, I discuss the design implications, the topic of diversity and inclusion in designing with children, areas that could have been improved, and promising directions for future work.

5.1 Design Implications

Practical design implications for the findings from this study would ultimately manifest the norms of true collaboration online. In the data collection phase, I facilitated two participatory design sessions with KidsTeam UMD and KidsTeam UW to gain an in-depth understanding of how design partners perceive technologies used in online KidsTeam and what they would want to improve in these tools. The session procedure is presented in chapter 3 and the session plans can be found in Appendix D and E. In the data analysis stage, I perform a thematic analysis with the artifacts generated from these two sessions. Many common usability principles in the field of HCI are identified in this phase. Such design principles include learnability, simplicity, affordance, etc. For example, design partners indicated that the label of the button "Clear Frame" on Jamboard was confusing, and hard to predict what would happen after clicking it. Some groups also pointed out features that were difficult to perform or took them too long to complete. In addition to the above usability principles, four design implications emerged from the participatory design sessions and would provide directions in designing technologies specifically for online collaboration with children: 1) flexibility and freedom, 2) fun and playful, 3) control sharing, and 4) customization.

5.1.1 Flexibility and freedom

One theme that stems from the participatory design sessions is the design partners' flexibility and freedom with technology tools. Previous work highlighted the importance of balancing freedom and structure for creativity in design (Makhaeva et al., 2016). Makhaeva et al. suggested that creative freedom offers possibilities for creative action and the structures focus the direction of the explorations. Johnson-Laird (1988) stated that "freedom of choice occurs par excellence in acts of creation". Such examples include "when an artist paints a picture, at each point there are several possible brush strokes that could be made." Our choice and freedom in online design sessions depend on the options we have among the tools we have access to. When KidsTeam design partners brainstormed design ideas, three concepts emerged: 1) assorted options, 2) reverse actions, and 3) online autonomy.

1) Assorted options

In the two participatory design sessions, many of the design ideas are surrounding the concept of adding a variety of options to the tool. Digital whiteboards such as Jamboard,

Zoom Whiteboard, and Google Slides are commonly used in online participatory design as platforms to brainstorm ideas. Child and adult design partners from different groups all agree that the current collaborative whiteboards do not have enough choices. This includes a wide variety of options in the toolbar, such as:

- a) Colors: design participants expected more colors for text, sticky notes, and more pen color options while they are scribbling on the whiteboard. An adult design partner shared that having colors that are not boring to children could be a great addition to engaging children in the design process.
- b) Sizes: design partners wanted to have the option to change the sizes of fonts, pens, erasers, lasers, etc.
- c) Styles: participants mentioned the font styles (typefaces or italics) they could choose were limited. They also added ideas such as adding more variety of pens, erasers, laser pens, and different shapes

2) Reverse actions

In the KidsTeam UMD participatory design session, the Jamboard group liked that they could use the undo button to reverse actions because this allowed them to quickly backtrack the previous states. However, some digital whiteboards do not support the undo and redo features. Additionally, one of the dislikes brought up by the Zoom group was that it was difficult for them to edit texts after finishing them on Zoom Whiteboard. *User control and freedom* is one of the usability heuristics presented by Nielsen (1994). In his work, this principle is focused on making actions reversible and minimizing the extent to which the system traps the user in a specific. As more technologies are designed for children, having the flexibility and freedom to undo prior actions is worth considering in the technology design process.

3) Online autonomy

One intriguing observation in the two design sessions was that all design groups showed no excitement about the technology tools they were assigned to brainstorm for, except the Padlet group in the KidsTeam UMD session. Before I hosted the participatory design session, KidsTeam UMD had been incorporating Padlet in a few online design sessions. Padlet is a collaborative web platform where users can share content with other collaborators. Some key features include uploading images from users' local devices, searching online resources and sharing to the boards, adding GIFs, YouTube videos, etc. I learned from the KidsTeam design sessions that images are much more appealing to children than text. There was a distinctive comparison in regard to participants' interests in Padlet and other digital tools. During Question of the Day, children shared that most of the tools were boring to them and those were similar to what they would normally use in schools. However, while brainstorming the likes for Padlet, design partners shared:

"We have the freedom to add as many images and that's a plus!"

"Padlet lets us upload lots and lots of cat pictures. We have the freedom to love cats!"

Figure 5 is the artifact generated by the Padlet group and provides the context of how design partners expressed they liked having freedom in Padlet. Children obviously enjoyed having the autonomy to add and share media with their peers. During the design session, the UW Jamboard group changed the background of their board and expressed that they like

having a feature to upload photos. While three design groups (Zoom, Jamboard, and Google Slides groups) enjoyed scribbling and adding annotations on the boards, the Padlet breakout group indicated that they would like to be able to draw on the board as well.



Figure 5: Part of the artifacts created by the Padlet group

5.1.2 Fun and playful

Following up on the Online Autonomy thread, the Padlet group thought Padlet was not only easy to use but also a tool with lots of fun – "we like everything. It makes KidsTeam fun!" During my observation in KidsTeam sessions and the interviews with adult design partners, I learned that children generally love drawing, scribbling, games, pictures, and videos, namely all kinds of fun elements. During the online participatory design sessions, children enjoy having the features to scribble, annotate, and use laser pen to draw attention from others. However, most of the technology tools we use in online participatory design are not interactive enough for children. These tools do not excite them, along with the online distraction and mixed contexts we discussed in 4.1.6 Lack of embodied experience altogether, children may thus lose interest in engaging in online design activities. Additionally, one of the design ideas generated by the UMD Jamboard group was to add games to the whiteboard. An adult design partner shared, "because of kids' imagination and the things they love, they generally imagine everything is a game." There have been studies pointing toward the benefits of incorporating games in intergenerational settings. Costa & Veloso (2016) conducted a review of past literature and suggested that digital games can enhance intergenerational interaction. A study by Zhang & Kaufman (2016) states that intergenerational play changes the modes of communication and traditional roles of young and older people. In the participatory design sessions and the interviews with adult design partners, I found that children are most familiar with games. Games present an easier and more intuitive way for children to express their thoughts. In Reis's work (2021), a gamebased approach can foster positive attitudes and connectivity between different age groups as games effectively help participants see each other as a peer. Games can bridge the generation gap and support equal participation because they are accessible to both children and adults (Reis, 2021). Therefore, I believe equal partnerships in online participatory design can be better achieved if the technology tools are tied closely to what kids love, such as games, fun elements, and interactive features.

5.1.3 Control sharing

"It's easier to spam in online sessions. It's power, and it's the power dynamic and the control." [Expert 1]

In *4.3.1 Child-adult interaction*, we have discussed sharing control is easier in-person than online. In the *Design for online KidsTeam* sessions with two intergenerational design teams, power-sharing was an emerging topic that both adult and child design partners had concerns about. When multiple design stakeholders use technology tools to collaborate in online environments, the control settings must be carefully considered. I further analyze the likes, dislikes, and design ideas surrounding control sharing and found two concepts that could shed light on the design direction: 1) role assignment, and 2) self space and ownership.

1) Role assignment

In each KidsTeam design session, there are typically a host who manages the session and other adult design partners as co-hosts in the breakout groups. The facilitator roles are more apparent in online participatory design given the fact that online sessions are more adult-directed. Clear role assignments and correspondent control settings can help mitigate the hurdles caused by technology in the intergenerational design process. Below, design partners brainstormed features that can help the host and co-hosts manage participatory design activities:

- A way for the host to disable annotation
- A way to freeze scribbling feature
- A "view only" mode when the design participants can not add new components

In 4.1.6 Lack of embodied experiences altogether, we discussed the distraction in online participatory design. Having different setting options based on the roles (host, co-host, participant) and the power to disable access to features can help design partners focus on the design activities and prevent distraction. In addition to the ideas generated in the design sessions, I also recommend that the tools should empower the host by having an "admin view". Specific feature ideas include an option to switch between the whiteboard mode when design partners are in breakout groups, and the presentation mode when the host merges the whiteboards and brings everyone along to the presentation. By reinforcing this, I believe design partners would pay more attention to the design activities as they should, but sometimes get distracted. This would also be easier for the team to conduct an affinity mapping and see the big ideas across the groups. Additionally, the admin view can allow seeing all of the whiteboards without switching between them so that the host can quickly check every group's progress and prioritize which group needs extra help.

2) Self space and ownership

When design partners were jotting down ideas, scribbling, or annotating with the tools, many of them addressed concerns with "accidentally deleting something that other people added" and "do not like that people can draw over my drawing". This indicates that design partners expect they would have self space and a sense of "ownership" of the items they created, even though we collaborate and share the boards online. Typically, the topic surrounding "who can manage which components" includes three actions: adding, deleting, and editing a component. From the design artifacts, I found that design partners were more sensitive about the items they create being deleted, in comparison with adding new components or editing other people's notes. One design idea from the UW Google slides

group is that a component should be chosen by only one person at a time to avoid accidentally deleting something that is being revised.

Additionally, children care a lot about their drawings. One of the dislikes from the UW Zoom group was "do not like that people can draw over my drawing", and the UMD Jamboard group shared that "someone drew all over the screen and it was distracting". In inperson participatory design, child design partners usually draw with their own physical materials, such as pens, papers, or journals, and have their personal space to draw. In online participatory design, however, design partners share spaces, and use collaborative digital whiteboards so that everyone can see everything. The digital whiteboard serves two purposes. The first purpose is relevant to the main design activities in which the design teams brainstorm ideas together, and the second purpose of the space is as a shared big paper for children to draw anything. Many design partners stated that it could be chaotic sometimes when the design activities and the scribbles are created in parallel. Potential design solutions include:

- Have a shared space for collaboration, as well as a dedicated space for individuals to annotate, jot down ideas, and draw as they do in in-person sessions
- Have a setting where a participant can not see other people's scribbles over the screen when it is set as "invisible" by the host

5.1.4 Customization

Customization has been a common topic in the domain of interface design. KidsTeam design partners also discussed customized settings such as restricting the media sources on Padlet by age, and being able to customize what types of images can be added to the whiteboard. Incorporating customization and *5.1.2 Fun and playful* could point towards an
interesting design direction specifically for the context of designing with children. An example I learned from the UMD Padlet group was that children wanted to be able to design their own avatars as animals (e.g., cheetah, wolf, cat) on Padlet. The customized avatars demonstrate their personalities, what they like, and how they feel at the moment. An adult design partner mentioned, "*how can we bring a sense of presence and collaboration into these tools? If we're in Padlet, is there a way that I can chat with someone on Padlet?*" From a design perspective, visually displaying avatars on the whiteboard is also an affordance that shows who is collaborating in the online space, while it's been harder to acknowledge each other's presence online. Additionally, I would recommend taking advantage of the avatars to reinforce one-on-one interaction by adding interactive elements. For example, adding buttons, such as a sending emojis button or a sending message button, allows design partners to interact with others. This way, the design session would be more enjoyable and engaging for both children and adults. This could also resolve some of the findings we discuss in chapter 4, such as *4.1.2 Lack of one-on-one interaction* and *4.1.6 Lack of embodied experiences altogether*.

5.2 Diversity, inclusion, and accessibility

"COVID forced us to rethink what it means to expand KidsTeam and keep it still good in this case, and what it means to think about inclusion, diversity, and equity." [Expert 2]

We have discussed many of the downsides in regard to online intergenerational participatory design, mainly the hindrance caused by technological barriers. However, this shift from in-person to online has also brought the teams new perspectives, even though the practices have not been perfect. From the interviews with the directors of two intergenerational design teams, I learned that the *diversity* of child design partners in KidsTeam is what both of them have been thinking about, such as socioeconomic status and racial stratification. The experts indicated that when they recruited child design partners, they would consider how to provide a diverse, inclusive, and equitable environment where children feel safe to express themselves. Hosting participatory design sessions with children online was hard for the teams at the beginning of the pandemic. However, one of the experts shared that the online setting has allowed us to think about how the team can expand and conduct participatory design with children where transportation is less of an issue. For example, parents used to take children to the university campus to participate in KidsTeam activities. The cost of time may be a hurdle when traffic is an inevitable issue in the area. From this perspective, technologies have been great additions to help reduce travel time and families' burdens. Online KidsTeam also provides great possibilities to involve children with diverse backgrounds in the design team when distance is not an essential factor. While technologies have great potential for diversification, we should still be aware of the potential issues with accessibility and equity. For instance, we would have to make sure every child has equal participation in the design activities with the technologies and resources they have at hand. Technology infrastructure includes software, hardware (devices and headphones), internet bandwidth, etc. The expert indicated that the technology infrastructure is one of the most critical issues of KidsTeam equity. Hence, when we take advantage of the benefits that technologies have brought us, I believe the foremost consideration is how we create an inclusive environment with technologies at the same time.

5.3 Limitations

One limitation of this study is that the data collection was limited to two intergenerational design teams. Although many of the intergenerational design teams follow Druin's cooperative inquiry method as a philosophy to design technologies for and with children (Druin, 1999), how each team applies the design techniques in online sessions and what technologies are incorporated in the participatory design process can be different. This might yield inaccuracy in our overall understanding of technology tools in online intergenerational participatory design teams. Therefore, I advocate that researchers further examine technologies in varying intergenerational design settings.

As presented in table 1, the two intergenerational design teams had different plans for structuring participatory design sessions in Spring 2022. KidsTeam UMD focused on fully online and in-person sessions, whereas KidsTeam UW had fully online and hybrid sessions. In this regard, I was not able to gather enough data from hybrid sessions in KidsTeam UMD and fully in-person sessions in KidsTeam UW. It would be helpful if comparable data across KidsTeam UMD and KidsTeam UW were collected. In this sense, we could draw insights from online, in-person, and hybrid sessions in two intergenerational design teams. Regardless, I address the research questions by conducting data analysis from the landscape of uncovering patterns between three participatory design settings (fully online, in-person, and hybrid sessions), rather than the participatory design practices between two intergenerational design teams (KidsTeam UMD and KidsTeam UMD).

5.4 Future Work

While intergenerational participatory design has just shifted online for a few years, this research has provided insights into the use of technology tools in this context. However, there are certainly various avenues for future research. The first direction of future work is a more diverse sample set because every intergenerational design team is operated in its unique way. In the data collection phase, it's noticeable that the two intergenerational teams incorporate different technology tools into the participatory design process. Each team also has its own approaches to executing participatory design techniques and structures design sessions differently. Additionally, the structure of a design team in terms of age groups, adultchild ratios, and the diversity of design participants should also be considered in the domain of intergenerational participatory design. Including more data points from various intergenerational design teams would bring to light potential improvements in the technology used in online collaboration between child and adult design partners.

Secondly, this work presents design implications as potential areas, yet has not implemented them with the intergenerational design partners. Future research could consider exploring these areas while designing technology tools for online intergenerational collaboration. In this study, the observed gaps between online and in-person participatory design are mainly about the limitations of the video conferencing tool as well as the digital whiteboards. When exploring design opportunities among these tools, I would also recommend involving both children and adults in the technology development process. Validating the design concepts with participatory design stakeholders would help inform design decisions because they are the ultimate users.

Third, this thesis has been focusing on technology tools used in online participatory design. However, as we have discussed in chapter 4, the technology tools and participatory design techniques are interconnected. These two aspects together affect how the intergenerational design partners cooperate in online environments. While technology tools have been examined in this study, I believe that some of the participatory design techniques, which were initially developed for in-person design activities, could have been improved for online sessions as well. New participatory design techniques specifically for online collaboration are also worth developing in this domain. Hence, future work could consider

investigating design techniques in online participatory design and shed light on best practices regarding how we incorporate both aspects in online participatory design.

Last but not least, this research has touched upon the concept of true collaboration in online environments through an examination of technology tools used in intergenerational participatory design. The new norms of natural collaboration online are worth studying. Some key questions concerning this topic include how humans feel truly connected online? What makes us collaborate seamlessly? Without being physically in the same space, what are the alternatives that allow us to have embodied experiences? When the video and audio are turned off, how do we acknowledge each other's presence and company? Additionally, most of the technology tools mainly focus on the online to online collaboration. In the real world, however, we are having more hybrid collaboration. When the collaboration involves some people online and the rest of the group physically in the same space, how do we let both sides understand where they are positioned, be able to freely jump in and out of conversations, and come back with more ideas and learnings? These questions have pointed to potentially fruitful avenues of future work. Hopefully, they can be further explored, and our collective knowledge in this domain can guide us toward the new norms of online collaboration.

5.5 Conclusion

While many intergenerational design teams pivot to online participatory design sessions to facilitate design sessions online, it is crucial to understand how the technology tools are used to execute participatory design techniques. This thesis examines the technology tools used in two intergenerational participatory design teams (KidsTeam UMD and KidsTeam UW) and explores what features are missing in these technology tools that suppress the execution of participatory design techniques. Past studies have developed collective knowledge regarding participatory design with children and distributed cooperation, yet the roles of technology in online participatory design have not been explored much. Through exploratory analysis of data collected from four methods (observation, participatory design sessions, semi-structured interviews with adults, and expert interviews), this thesis identified three themes regarding how technology tools impact collaboration with children online: 1) social ability online, 2) technical challenges, and 3) power dynamics in online participatory design. The findings presented in this work contribute to the processes of participatory design with children online, as well as the broader area of design work with all ages where synchronous collaboration is needed. Design implications have been discussed in this work in the hope that we can mitigate the hurdles caused by technology and thus achieve equal partnership in the intergenerational design process. This work can also shed light on how we can design better technology tools that reinforce online collaboration for wider technology users, not just children. As we shift towards mixed-context collaboration, I advocate that research should continue to explore the norms of true collaboration online.

Appendices

Appendix A: KidsTeam Adult Observation Protocol - Online Session

Date	
Your name	
Kids in your group	

Design Activities & Participatory Design	What worked well:		
	What worked not well:		
	Other thoughts:		
Online Tools, Hardware & Software	What worked well:		
E.g. Zoom, Jamboard, Padlet, etc	What worked not well:		
	Other thoughts:		
Design Partners' Interaction	Whole group:		
E.g. Kids and Adults, Between Kids, Between Adults	Adult-Kid:		
	Kid-Kid:		
	Adult-Adult:		
Anything stood out to you?			
Feel free to share your notes, observations, etc. Your thoughts are greatly appreciated!			

Appendix B: KidsTeam Adult Observation Protocol - In-person Session

Date	
Your name	
Kids in your group	

Design Activities & Participatory Design	What worked well:
	What worked not well:
	Other thoughts:
In-person tools, Design materials <i>E.g. whiteboard, big papers</i>	What worked well:
	What worked not well:
	Other thoughts:
Design Partners' Interaction	Whole group:
E.g. Kids and Adults, Between Kids, Between Adults	Adult-Kid:
	Kid-Kid:
	Adult-Adult:
Anything stood out to you?	
Feel free to share your notes, observations, etc. Your thoughts are greatly appreciated!	

Appendix C: KidsTeam Adult Observation Protocol - Hybrid Session

Date	
Your name	
Kids in your group	

Design Activities & Participatory Design	What worked well:
	What worked not well:
	Other thoughts:
Digital Tools, Hardware & Software E.g. Zoom, Jamboard, Owl camera, Padlet	What worked well:
	What worked not well:
	Other thoughts:
In-person tools, Design materials <i>E.g. whiteboard, big papers</i>	What worked well:
	What worked not well:
	Other thoughts:
Design Partners' Interaction	Whole group:
Between Kids, Between Adults	Adult-Kid:
	Kid-Kid:
	Adult-Adult:

Anything stood out to you?

Feel free to share your notes, observations, etc. Your thoughts are greatly appreciated!

Design for Online KidsTeam – April 28, Online

Materials: Zoom, digital whiteboards, Google jamboard

4:30 - 4:40: Snack and Unwind

Snack time – hanging out and checking in with kids. Snack serves as a transition to co-design as a team later.

4:40 – 4:55: Circle Time

Introductions

Although we're having all KidsTeam sessions in-person now, I am wondering how was your experience with Online KidsTeam. If we are back to online someday, I want to know how we can make our online co-design activities better. So we're designing for Online KidsTeam today.

Question of the Day

Large group discussion with zoom whiteboard -

Q: What is your favorite online tool that we have used and why? What is your least favorite?

5:00 – 5:40: Design Activity

Design Task Description and Design Prompt

In one of our KidsTeam sessions in February, we discussed the pros and cons of being online. Today, I want to specifically discuss the tools that we have been using in online Kidsteam, such as zoom, jamboard, whiteboard, padlet. We'll be spending 15 minutes brainstorming the good and bad things of these tools on Jamboard. Then, spend 25 minutes discuss how we can improve the tools, or design our own tools that we can use in Online KidsTeam. What features would you want in the new tools? // Assign kids and adults into groups

// Make adults as co-hosts so they can record the breakout rooms

Groups

	Group 1	Group 2	Group 3
	Zoom(including whiteboard)	Jamboard	Padlet
Kid Partners:			
Adult Partner(s):			

Big Paper on Jamboard (15 minutes)

Brainstorming the good and bad things of the tool – zoom(including whiteboard), jamboard, padlet.

- Sticky notes: use green sticky notes to jot down good things of the tool and pink stickies for bad things.
- Card sort: rank the top 3 good and bad things.

Big Paper on Jamboard (25 minutes)

Brainstorming ways we can improve the tool, or designing new features for the online tools – zoom(including whiteboard), jamboard, padlet.

- Sticky notes: use different colors of sticky notes to write down ideas in category of
 - Improvement
 - o New feature
 - Some fun stuff that is nice-to-have
- The goal is to solve as many bad things of the digital tools as you can!

5:40 – 6:00: Presentations and Themes

Each group will present their work, followed by a short presentation of the themes we discovered during our session. If possible, I would like to see if we can quickly do Mixing Ideas with design partners to have a summary of their good ideas.

6:00: Debrief

Adults will debrief on their impressions and observations from the session. After the session, I will take notes on the jamboards, debrief sessions, my own observations, and see the themes in the discussion.

Appendix E: KidsTeam UW Participatory Design Session Plan

Design for Online KidsTeam – May 3, Online

Materials: Zoom, digital whiteboard, Google jamboard

4:00 – 4:10: Arrival

Snack time – hanging out and checking in with kids. Snack serves as a transition to co-design as a team later.

4:10 – 4:20: Circle Time

Introductions

In KidsTeam UW, we have Online and Hybrid KidsTeam. I am wondering about how you think about the tools that we've been using. I want to know how we can participate in our co-design activities with better digital tools. So we're designing for Online KidsTeam today!

Question of the Day

Large group discussion with zoom whiteboard -

Q: What is your favorite online tool that we have used and why? What is your least favorite?

4:20 – 5:05: Design Activity

Design Task Description and Design Prompt

We are going to spend 15 minutes focusing on the likes and dislikes of the tools. Then, we'll spend 25 minutes brainstorming design ideas to fix the dislikes of these tools.

// Assign kids and adults into groups

// Make adults as co-hosts so they can record the breakout rooms

Groups

Floater(s): Ting			
	Group 1 Zoom(including whiteboard)	Group 2 Jamboard	Group 3 Google slides
Kid Partners:			
Adult Partner(s):			

Big Paper on zoom whiteboard/jamboard/padlet (15 minutes)

Brainstorming the likes and dislikes of the tool – zoom(including whiteboard), jamboard, padlet **on that platform**.

- Sticky notes: use green sticky notes to jot down likes of the tool and pink stickies for dislikes.
- Card sort: rank the top 2 likes and dislikes.

Big Paper on Jamboard (25 minutes)

Brainstorming ways we can improve the tool, or designing new features for the online tools – zoom(including whiteboard), jamboard, padlet.

- Sticky notes: use different colors of sticky notes to write down ideas in category of
 - o Improvement
 - o New feature
 - Some fun stuff that is nice-to-have
- The goal is to solve as many bad things of the digital tools as you can!

5:05 – 5:15: Presentations and Themes

Each group will present their work, followed by a short presentation of the themes we discovered during our session. After the presentation, I'll ask kids to choose their top two design ideas and see if they have further thoughts on the ideas.

Appendix F: KidsTeam Adult Interview Protocol

Introduction

Thank you for participating in the interview today! I have been learning a lot from your observation of our KidsTeam sessions. So today, I want to follow up on your observation protocol and learn more about your thoughts on online participatory design activities, and the tools that we have been using in online sessions. The interview is going to last for an hour. If you don't feel comfortable, we can always pause our interview. Feel free to let me know if you have any questions or concerns during the interview.

[Sign the consent form and start recording]

Warm-up

- 1. Before we start, can you tell me more about yourself?
- 2. How long have you been on KidsTeam?

KidsTeam General Questions

So you have been with KidsTeam for ____ months/years,

- 1. Do you remember what motivated you to join KidsTeam?
- 2. For the time you've been with KidsTeam, what are the experiences that you hope to get AND offer to the team?
- 3. Based on what you hope to offer to the team, how would you reflect your experience with KidsTeam so far? Is there anything you would like to do better?
- 4. What is your most enjoyable part of participating in KidsTeam activities?
- 5. What is the most challenging part of participating in KidsTeam activities?

Online/Hybrid/In-person Participatory Design

- 1. [UMD adult] We have online and in-person sessions for this academic year, which type of sessions have you participated in?
- 2. [UW adult] We have online and hybrid sessions for this academic year, which type of sessions have you participated in?

- 3. How do you think the online KidsTeam has been going?
- 4. How do you think the in-person [hybrid for UW] KidsTeam has been going?
- 5. How do you compare these two different types of participatory design sessions with the team?
- 6. What do you see are the differences in kids' and adults' participation?

Digital tools

As you may know, my research focuses on how the technologies are used to facilitate online/hybrid participatory design sessions with kids, and how tools affect the power dynamics between design partners.

You have a lot of great observations in the protocol! I am sending you the link in the chat now. We can walk through it and talk more about your thoughts. I have highlighted some important points in the google docs.

- 1. Can you tell me more about your observation in the digital tools(hardware & software) part?
 - a. What worked well
 - b. What worked not well
- 2. In terms of the tools that we've been using in online or hybrid sessions, what do you think about them?
 - a. UMD zoom, google jamboard, google slides, whiteboard, padlet
 - b. UW zoom, google jamboard, google slides, whiteboard, owl camera
- 3. Could you compare the use of digital tools to in-person tools/materials in terms of ...
 - a. Implementation of participatory design activities In reference to what you have said, is there anything you will do differently or want to explore in future years?
 - b. Interaction between design partners In reference to what you have said, is there anything you will do differently or want to explore in future years?
- 4. In terms of design partners' interaction in online sessions, can you tell me more about your observation ?
 - a. Whole group
 - b. Adult-kid
 - c. Kid-kid
 - d. Adult-adult

5. What about design partners' interaction in in-person [hybrid for UW] sessions? What do you think are the differences between online and in-person sessions ?

Wrap-up

1. Is there anything you think is relevant or important to this topic, but we haven't talked about that you would like to share?

Thank you so much for your time today! Do you have any questions? I have been learning a lot from you and I appreciate your insights.

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