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Opinion paper

Distributing participation in design: Addressing challenges of a global pandemic

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ABSTRACT

Participatory Design (PD) – whose inclusive benefits are broadly recognised in design – can be very challenging, especially when involving children. The recent COVID-19 pandemic has given rise to further barriers to PD with such groups. One key barrier is the advent of social distancing and government-imposed social restrictions due to the additional risks posed for e.g. children and families vulnerable to COVID-19. This disrupts traditional in-person PD (which involves close socio-emotional and often physical collaboration between participants and researchers). However, alongside such barriers, we have identified opportunities for new and augmented approaches to PD across distributed geographies, backgrounds, ages and abilities. We examine Distributed Participatory Design (DPD) as a solution for overcoming these new barriers, during and after COVID-19. We offer new ways to think about DPD, and unpick some of its ambiguities. We do this through an examination of the results from an online Interaction Design and Children (IDC) 2020 workshop. The workshop included 24 researchers with experience in PD, in a range of forms, in the context of children. Initially designed to take place in-person and to include a design session with children in a school in London, the workshop was adjusted to an online format in response to the COVID-19 pandemic. Despite the adverse circumstances, we discovered that the unexpected change of the workshop style from in-person to online was an opportunity and an impetus for us to address the new PD challenges of the global pandemic. In this article we contribute seven themes which were revealed during our IDC workshop, providing guidance on important areas for consideration when planning and conducting PD in the context of a global pandemic. With a focus on the term 'distributed', we offer insights on how DPD can be applied and explored in these circumstances with child participants. We conclude with a number of lessons learned, highlighting the opportunities and challenges DPD offers to enable continued co-design during a global pandemic. In particular, DPD provides greater access for some populations to be involved in PD, but technical and social challenges must be addressed.

1. Introduction

The COVID-19 pandemic changed the conversation around Participatory Design (PD) with children. While core concerns remain the same – How can we support the inclusion of diverse groups of children in PD? How can we ensure children's ideas are preserved and translated into requirements and new technologies? – new norms of social distancing and a move to online learning for children around the world dramatically changed the dynamics PD researchers have long taken for granted. Traditional in-person PD approaches, which involve close socio-emotional and often physical collaboration between participants and researchers, can no longer be run in many parts of the world.

This paper was inspired by a workshop run at IDC (Interaction Design and Children) 2020 (Constantin, Korte, Wilson, Alexandru, Good, Sim, Read, Fails, & Eriksson, 2020), which was similarly upended when the conference moved online. Our plan to create the World's Most Inclusive PD Project had to pivot, to focus more on how such a project could be run in a world with limited in-person interaction. The workshop attracted researchers with

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experience in in-person PD (Baykal & Eriksson, 2020; Björling & Alves-Oliviera, 2020; Bonsignore, 2020; de Angeli, Finnegan, & Scott, 2020; Neto, Nicolau, & Paiva, 2020; Read, Sim, & Yusof, 2020; Sharma, Kinnula, Iivari, & Norouzi, 2020), as well as "online" (Bonsignore, 2020; Fails, Ratakonda, & Ogumoro, 2020) or "distributed" (Neto et al., 2020) PD, which was prompted by the COVID-19 pandemic.

Within the workshop we focused on a series of questions: *How to collaborate and effectively build upon others' ideas when you are not co-present? How to overcome the sense of "artificiality" when presenting and sharing ideas virtually? How to promote the involvement of children with special needs? How would the presence of parents and other family members change the dynamics of design with children? How to socialise online? How to recognise and re-engage disengaged children? How to avoid or resolve conflicts over the control of technologies and design outcomes?*

Despite the adverse circumstances, we found that the unexpected change of the workshop style from in-person to online was an opportunity and an impetus for us to address several new challenges caused by the global pandemic. In this paper, we present an overview of the workshop and summarise what was learned from the discussions. Based on an analysis of material from the workshop, we highlight seven themes that capture the opportunities and challenges of design with children in non-face-to-face situations: Participation in Online Environments; Maintaining Engagement; Sense of Connectedness/Togetherness; Accessibility, Diversity and Inclusion; Power Dynamics; Developing Skills; and Administration, Pragmatics and Logistics.

We conclude with a series of lessons learnt and future directions which may merit further attention from PD researchers.

1.1. Definitions

It is important to clarify the use of common and new terms as they apply to children's participation in design. These definitions arose from the conversations within the workshop, and subsequent analysis of the ways in which workshop participants described their previous experiences (during the workshop and within their position papers).

- *Participatory Design (PD)*: is used in its broadest sense in this paper to refer to the participation of children in design where the aim is to empower them to co-design solutions in line with the broad traditions of democracy and empowerment. When we refer to PD in this paper it is to the philosophy of PD (Ehn, 2008).
- *Co-Design (CD)*: is used as an umbrella term for a set of practices and methods that are widely reported in IDC literature and beyond, that span short one hour informant sessions, day long design workshops and extended incremental design projects.
- *Distributed Participatory Design, (DPD)*: is used to describe the range of situations in which all or most design team members are physically and perhaps temporally dispersed. This requires coordination of activities across locations and time zones, to ensure equitable participation in and contribution to design activities.
- *Online PD*: refers to any design practice where the design conversation is facilitated through an online portal, as opposed to in person.
- *Non-present PD*: is used to refer to PD interactions where researchers and participants are not co-present, and includes DPD and online PD.

We also clarify our terminology around disability. As the majority of the authors are from the UK context, we have opted for the term "children with special needs" as a catch-all. This was decided after much deliberation, taking into consideration the on-going discussions in various communities over person-first vs identify-first language. In some cases, where a particular community's preference for person-first or identify-first language is known to one of the authors, it has been used within the paper.

2. Experiences from the IDC workshop

2.1. Incorporating design with children into the workshop

The IDC workshop included an online design experience with children, as a shared, sensitising experience for all workshop participants. On the morning of the workshop, a design brief was given online by one of the workshop organisers to a group of children in a school in the UK which remained open during the pandemic for the children of key workers. The children then had some time to work on the task, using paper and pencils, and the results from the design brief were later presented directly to the workshop participants. The presentations took place live via video conferencing (Zoom[1]) by the children themselves, or by the teacher in the cases where the children were too shy.

The design brief presented to the children was: "Designing for Closeness. Think of someone you have missed being close to this last few months. Think about how technology (computers and smart things) could have maybe brought you closer. Today we are going to ask you to DESIGN a NEW 'thing' that could have been good to have had". Some examples of the children's designs were:

- "I miss my Friend Mollie" — a robot programmed to act like a human
- A phone where a hand comes out to shake your hand
- iVirtual — an app where you have to wear glasses but you can see your friend in 3D and it makes you feel that you are right next to them
- A teddy bear that smells like your friend, and with an iPad on the belly where you can see your friend
- A panda bear that you connect your phone to, and you can call anyone, but the panda is only for FaceTime[2]
- "Talking Gadget 3000" — a gadget you can talk into, and touch people in 3D

In the workshop discussion afterwards, we talked about the design session in order to position it in terms of the roles and agency of the children. In this example, the children's teachers had acted as facilitators rather than as co-designers. They had supplied the encouragement and the motivation but had left the children to work largely uninterrupted. Due to the school having to impose social distancing measures due to the COVID pandemic, each of the children worked alone in brainstorming and documenting their individual ideas, rather than collaborating together and building on each other's ideas, as is generally expected in co-design activities. Due to the brevity of the event and the lack of opportunity to build on ideas or to see how the designs might be further implemented, this design session would not be described as a classic PD session. However, as a micro-event it was useful to expose and foreground some of the possibilities and practicalities of design with children in these circumstances. It also gave a concreteness to the workshop and gave all participants a shared experience which helped discussion and sparked constructive reflection on children's participation in design.

[1] https://zoom.us.

[2] https://apple.com; FaceTime allows for video calls.

Table 1
Overview of themes in relation to time: before, during, after, or continuously.

Theme	Before	During	After	Cont.	Section
Participation in Online Environment	X	X			3.1
Maintaining Engagement		X			3.2
Sense of Connectedness/Togetherness		X	X		3.3
Accessibility, Diversity and Inclusion	X	X	X		3.4
Power Dynamic	X	X	X		3.5
Developing Skills	X	X	X	X	3.6
Administration, Pragmatics, Logistics	X	X	X		3.7

2.2. Workshop materials and analysis

In order to document and collect workshop materials, we used the Zoom web conferencing platform,[3] and Miro boards.[4] The recordings or transcripts thereof from each session (except the session which involved children, which was not recorded due to ethical reasons) were analyzed together with the notes collected in Miro and the position papers. We used an inductive approach to Thematic Analysis (Braun & Clarke, 2006) which resulted in seven themes, as shown in Table 1.

In our workshop we used terms like PD, DPD, online PD and non-present PD with some interchangeability. This was expected, as the participants each had different interpretations of these terms and as all of these terms are used with such variability in the literature. In regard to DPD, there are many variants including online, offline and hybrid approaches. When PD is carried out online it may be being described in a variety of ways but it may also be being done in a variety of ways: the participants and researchers may be physically dispersed but meeting synchronously, or there may or may not be online interaction with the researcher leading the session. Distributed PD may require an internet connection or could simply be a shipment of paper. In the narrative that follows, we tend to use the term PD as a catch-all, online PD to refer to a PD session that is certainly and definitively carried out online, with DPD being reserved for the specific situations in which there is a certain need to describe something that is distributed. We come back to the terminology later in the paper (Section 4.6) where we try to unpick what DPD might mean in the context of PD across space and time.

3. Key themes

In this section, we present the key themes which we identified in our analysis, as described in Section 2.2. These themes constitute opportunities and challenges that non-present PD presents for researchers. The themes address both the backstage and front stage work of PD, and are relevant before, during, after the PD activity, as well as continuously (see Table 1). Oftentimes, the actual encounters with the participants in design activities (e.g. workshops) are considered to be the drivers of PD processes (Bødker, Dindler, & Iversen, 2017). However, behind these activities are preparations and other forms of backstage work that fundamentally shape the setup and outcomes of the entire PD process.

3.1. Participation in online environments

Children working and interacting in an online environment is not a new concept. Researchers have studied how children interact online, within a wide range of different contexts including play (Marsh, 2010) and online learning (Tsuei, 2011), and research has also shown that children spend a considerable amount of their time online (Livingstone, 2019). The COVID-19 pandemic has seen children in multiple countries move to online learning (Adnan & Anwar, 2020; Andrew, Cattan et al., 2020; Dhawan, 2020; Dong, Cao, & Li, 2020; Engzell, Frey, & Verhagen, 2020; Flack, Walker, Bickerstaff, & Margetts, 2020).

There has been considerable research in the area of communication and the use of technology to support computer collaborative work. Communication online is usually characterised as asynchronous (e.g. through email and discussion forums) or synchronous (e.g. through real time communication tools such as Zoom and FaceTime). Within the analysis of these tools there are many theoretical frameworks (Horton, Sim, Zaman, & Slegers, 2019; Humphry & Hampden-Thompson, 2019; Short, 1976) such as social presence, referring to the degree to which one perceives the participants' presence in the communication that is occurring. The Social Presence Model judges the quality of communication between two or more communicators through a medium (Short, 1976). Within the context of design with children online, this may refer to the researchers interacting with children through a medium such as Zoom or Microsoft Teams.[5] Communication via highly visual cues, such as facial expressions, gestures and eye contact, leads to a high social presence, whilst fewer visual cues tend to lead to task-based communication. The quality of video and audio is important when using online environments to facilitate PD or research activities with children, to ensure a warm and friendly dialog with a high social presence. This may also be important when trying to explain the task, explain ethics and ensure that the children and their teachers or parents understand the activity. A study by Humphry and Hampden-Thompson (2019) found that social presence is dependent on the quality of the pupil-tutor interpersonal relationship. Therefore, one of the challenges of working within an online space may be how to build and develop relationships with the children remotely so they are comfortable when participating in research activities. This may require a relationship-building phase prior to commencing research, as seen in the in-person PD literature (Horton et al., 2019; Wilson, Brereton, Ploderer, & Sitbon, 2019).

Many online communication and collaboration tools, such as Microsoft Teams and Miro, are not designed specifically for children. Children may appropriate and use them, but they are not designed to facilitate PD with children. It is unclear the extent of the usability issues children experience as they work independently, or how those issues may impact their enjoyment or understanding of the design activity. Asynchronous tools may hinder the children's ability to get instant feedback on their designs and may be more appropriate for emailing artifacts at the end of the session to the researchers. Because email is not secure, this may cause issues with ethical approval for data storage and transmission. Therefore care needs to be taken in the selection of the tools, and if a range of tools are required, understanding the extent to which they are child friendly, secure and freely available is important.

There are many barriers and challenges when using online environments to facilitate research, ranging from technical to practical aspects such as poor connectivity, financial constraints and lack of access to technology. There are practical considerations such as how to "read the room" and recognise disengaged children if cameras are off and non-verbal cues cannot be read; how to support children to remain on task; and how to provide feedback. Furthermore, children can easily be non-present and they may easily get distracted, thus it may be difficult to keep

[3] Zoom allows for audio and video recording of meetings, as well as saving text chats.

[4] https://miro.com/; Miro provides an infinitely zoomable canvas and web whiteboard for shared note taking.

[5] https://www.microsoft.com/en/microsoft-teams/group-chat-software.

Table 2
Summary of opportunities and challenges in the theme Participation in the Online Environment.

Participation in the Online Environment	
Opportunities	Challenges
• Children learning online collaboration skills • Children's ability to use familiar technologies • Increased technology exposure through the children's technology use • Wide array of tools available for online collaboration • Avoidance of disruptions (e.g. children acting out could be muted)	• Some online collaboration tools not child-friendly or accessible • Children limited by technology available to them • Increased dependency on adults for technical support • Lack of connectedness to other design team members • More distractions and disruptions than in PD • Reduced non-verbal communication • Facilitation challenges in "reading the room"

them focused, motivated and engaged enough by a screen. On the other hand, some children may want to dominate and take over the screen, which can act as a distractor for other children. All of the above can lead to collaboration challenges, and therefore, can also lead to an opportunity for learning about how to collaborate online. This presents scope for the Child–Computer Interaction Community to develop new tools and techniques to overcome some of the practical challenges to facilitate PD research within online platforms. (This section is summarised in Table 2.)

3.1.1. Technology - opportunities and issues

It is difficult to decide on the tools and devices to be used for communication/collaboration during DPD with children. Some examples of online tools that were raised in the workshop were tools to express ideas (e.g. shared whiteboards like Miro), communication tools (e.g. Trello,[6] Slack,[7] Zoom), game based tools (e.g. Minecraft[8]), and programming and interactivity (e.g. Scratch[9]). Selection of online tools should take into consideration the technological affordances ("action possibilities"), the link between these and the goals of the PD studies, as well as between these and the (child) participants' prior experience. There are many tools to consider, but even those tools which are meant for children may not necessarily be child-friendly or well-suited for design activities and purposes. There are issues with accessibility, the children's internet connection, and technology proficiency. Moreover, one must consider whether to allow children to use their own devices and thus manage different devices to increase accessibility (with an added support cost) (Bonsignore, 2020), or purchase the same device for everyone to level the playing field (with an added initial monetary cost for devices and setup) (Fails et al., 2020). Adults and children participating in online PD may need to be trained in the use of technology. There is also an increased dependency on adults to manage children's use of technology, which may result in a power imbalance. Another challenge in PD with children is tracking idea ownership. Technologies which support traceability of actions can help to overcome this challenge, although this can also raise new privacy issues. Finally, there are cultural differences in what tools are more common or available in various national contexts. This raises the question if there is a need to develop a dedicated environment/platform to support online PD (Constantin & Hourcade, 2018; Heintz, Law, Govaerts, Holzer, & Gillet, 2014; Walsh et al., 2012).

[6] https://trello.com/; Trello is a web-based list-making application for team collaboration.

[7] https://slack.com/; Slack is a communication platform to support collaboration in teams.

[8] https://minecraft.net/; Minecraft is a sandbox video game developed by Mojang.

[9] https://scratch.mit.edu/; Scratch is a free programming language and online community.

3.2. Maintaining engagement

Engagement is crucial in the process of PD (Zhang & Zurlo, 2020). While participation refers mainly to the "perspective of methodology and outcomes of the PD process" (Zhang & Zurlo, 2020), engagement is seen through the motivations, needs and autonomy of the participants that lead to "positive, interesting and immersive experiences" (Zhang & Zurlo, 2020).

Our workshop discussions revealed a series of aspects related to the positive impacts of technology, as a means of conducting online PD, and maintaining and increasing engagement (summarized in Table 3). In other words, online environments and tools can (as discussed in Section 3.1 above) provide opportunities for improving engagement. That is because children are attracted to technology, but also due to the flexibility technology affords. For example, since technology allows synchronous and asynchronous work to be supported, people can engage at their own pace, time, and location. However, it is worth flagging one potential counterpoint — it can be easier to engage children in the PD activities while working synchronously. As mentioned in the workshop: "working with peers (even remotely) can be engaging".

Technology allows for rapid switching from large group work to small groups and individual work. For example, using a breakout rooms function which exists within many online collaborative platforms (e.g. Zoom) quickly facilitates large to small group transitions. Also, with technology-mediated PD, access barriers are concentrated around minimum technology requirements. This means children who may be unable to physically meet for PD for a range of reasons (e.g. transportation) may have opportunities to join in PD activities.

Workshop participants suggested several strategies that can be used when running online PD sessions, such as using gamification to encourage children to participate and share their ideas. Gamification that involves using game design elements in non-game contexts has been recognised as having positive impact on user experience, including user engagement (Deterding, 2016). Indeed, as Douglas and Hargadon emphasised, engagement – which is a common metric used to gauge value – has a hedonic dimension to it (Douglas & Hargadon, 2000).

Providing feedback and encouragement while working synchronously can boost children's engagement, as it does in the traditional co-located PD setup (Iversen, Smith, & Dindler, 2017). When working with children, adults (particularly parents and teachers) play an important role in boosting children's engagement and supporting their involvement (Cumbo, Eriksson, & Iversen, 2019; Korte, 2018; Read et al., 2002). With online PD, it can be easier to bring together children and parents, since, as expressed by one of the workshop participants, technology "gives more space and time to work". The ratio of adults to children was brought into discussion by participants, who considered that it should be high. Based on their experience, participants recommended no more than 2 children per adult in order to effectively support children to engage in online PD activities.

While technology has a number of benefits on a child's engagement in the PD process, there are still some concerns. The

Table 3
Summary of opportunities and challenges in the theme Maintaining engagement.

Participation in the Online Environment	
Opportunities	Challenges
• Positive impact of technology • Children attracted to technology • Engaging participants at own pace, time, space	• Lack of access to technology amongst certain groups • Technology hiccups • Power difference • Lack of connectedness to other design team members • Difficulty with recognising and maintaining engagement

most significant is that barriers to online activities, in the form of insufficient technology access, will disproportionately affect children from lower socio-economic backgrounds. Once children are able to engage with online activities, design teams must face the issue of technology "hiccups" - unexpected problems and events, such as audio problems, accidental disconnection, or internet malfunctions. These may negatively affect interaction during PD and hence impact children's engagement. Another concern refers to the power difference that is commonly addressed in PD methods; when children rely on parents for technical assistance, the power differential between parents and children is harder to address within the context of the home. Finally, during online PD, it is more difficult to get the ambient information or read non-verbal signals such as body language, which contribute to the communication of participants' emotions and enable holistic assessment of their engagement.

There are a number of questions related to facilitating, maintaining and measuring engagement in DPD to be addressed in the future. How can we overcome the technology access gap to support inclusion and engagement of children from a wider array of backgrounds? How should we take advantage of technology to foster and maintain engagement during the online PD process? What tools should we use to understand participants' emotions and engagement?

3.3. Sense of connectedness/togetherness

In this theme, we consider how to imbue DPD work with the rapport, human connectedness and togetherness which are fundamental in the process of PD (Dindler & Iversen, 2014). The concept of 'togetherness' can be understood as the product of successful interaction rituals (Bergström, 2012). According to Collins (2004), who bases his work on Goffman (1961) and Durkheim (1912), a successful interaction ritual between people creates, among other things, group solidarity and a sense of membership. On an individual level it creates a "feeling of confidence, elation, strength, enthusiasm, and initiative in taking action" (Collins, 2004, p. 49). In the field of psychology, a sense of togetherness with others (described as relatedness) is a central tenet of the concept of self-determination (Deci & Ryan, 2011), otherwise known as agency, subjective wellbeing, and one's drive to lead a thriving and meaningful psychological life.

In design, personal and professional relationships are a fundamental and driving force (Dindler & Iversen, 2014). Interpersonal interaction and connection are key to the success and sustainability of the PD process and the technologies which are produced (Dindler & Iversen, 2014). This relational perspective, which focuses on connectedness and togetherness, is key in PD, particularly when designing with marginalised communities (Soro et al., 2019; Wilson, Sitbon, Ploderer, Opie, & Brereton, 2020). Very often, when working with children, and, in particular with children with special needs, it is the act of "showing up" time after time, showing kindness and interest in the children, and becoming a playful co-participant in their contexts that helps designers build the trust and rapport that is crucial to PD practice. Through building this relational and foundational understanding of the children, we can support their self-expression, social interaction and engagement in the process of PD (Wilson et al., 2019; Wilson, Sitbon et al., 2020).

During our workshop, we experienced a lack of this fundamental component of PD – *connectedness*. We found that the physical and temporal asynchronicity of the DPD process impacts upon the socio-emotional connectedness and togetherness that is the backbone of PD (Dindler & Iversen, 2014). Through video platforms, participants and organisers could see each other's faces, but we lacked a more embodied understanding of each other. It was felt that the pixelated, digitised versions of each other that we see online are poor stand-ins for the complexity of real humanness. Particularly, non-verbal interactions or small 'aside' conversations which one might have one-on-one with participants and children are denied. These are a natural social strategy for building connection with others, but the 'group call' modality of most video calling platforms makes these forms of relationship building challenging. During the workshop, we found it hard to "read the room" and, therefore participants and organisers alike felt a sense of artificiality when presenting and sharing. When discussing experiences on how to address this in work with children, we highlight that many video call platforms have mechanisms to support one-to-one discussion, such as private chat channels. These may be helpful in building up rapport with individual children (Antle & Frauenberger, 2020). However, in the context of children with special needs, engaging in group video PD work while also managing other streams of incoming information, such as private chat channels, may be detrimental to engagement (as per Section 3.2) and may not align with children's abilities or be overwhelming.

This new modality of social interaction in design requires new rules and approaches. We discussed creative ways to build crucial rapport and a sense of a shared space where openness and creativity are welcomed. Ideas included setting up new socio-interactional rules which deviate from in-person settings. These include fostering spontaneity (e.g. allow screen sharing whenever desired), simulating social interactions (e.g. sending snacks or materials to children by post), and making room for fun and play (e.g. movement breaks, song breaks). We also identified an opportunity for adapted cultural probes (Gaver, Dunne, & Pacenti, 1999) to foster connectedness. For example, future DPD methods may include sending out design packs to children in advance of the session which include a) required design materials and b) "fun stuff" which the children can interact with during the sessions (e.g. games through which to support social cohesion — to be used as icebreakers or during breaks).

It is perhaps assumed that the asynchronicity of DPD may negatively impact connectedness and togetherness during design, as design work is conducted at different times by different people. However, as will be discussed in Section 3.4, the asynchronicity of DPD also allows for children to work at their own pace and in line with their own abilities, which especially supports younger children and children with special needs (Allsop, Gallagher, Holt, Bhakta, & Wilkie, 2011). From a connectedness/togetherness perspective, this is important, as such asynchronicity can provide children with more time for e.g. sensory processing, clarification

Table 4
Summary of opportunities and challenges in the theme Sense of Connectedness/Togetherness.

Sense of Connectedness/Togetherness	
Opportunities	Challenges
• New modes of creative practice • New methods for distributed social cohesion • Asynchronous DPD supporting special needs e.g. sensory processing time	• Lack of embodied understanding of each other • Lack of opportunity for non-verbal interaction

of tasks, creative expression, support from adults, and breaks or pauses as individually needed. While this may seem to foster *dis*-connectedness or *un*-togetherness, it also presents an opportunity for PD researchers to understand children's strengths, interests, and abilities prior to PD sessions (Wilson et al., 2019). Asynchronicity provides an opportunity for researchers to review and reflect on children's design ideas prior to live sessions, thus building a picture of the individual child or group of children and their design needs. We can then integrate our understanding of the children, gleaned from their asynchronous work, into our methods and design briefs for use in live PD sessions. This approach supports reflection and flexibility, making design sessions more relevant, and allowing researchers to better prepare for meaningful design work. The asynchronicity which may be present in DPD, may also serve to strengthen children's sense of connectedness to tasks — doing design work prior to a session provides time for grasping the task, and may support recall and memory during the session, which is particularly important in disability contexts. (This section is summarized in Table 4.)

3.4. Accessibility, diversity and inclusion

There is a growing tendency to include developmentally diverse children in the design process (Börjesson, Barendregt, Eriksson, & Torgersson, 2015). However, it is most commonly children on the autism spectrum who are involved in design (Börjesson et al., 2015), something that cannot be explained by the prevalence of autism in society (Boyle et al., 2011). Borjesson et al. call for the need to devise and investigate design approaches and methods for mixed groups of children — children with different disabilities as well as developmentally diverse and typically developing children (Börjesson et al., 2015). In many schools, children with a range of different abilities are often grouped together with typically developing children, meaning that technologies for children and the methods for involving children in the design of technologies should be adapted to accommodate diversity within groups.

There are many methods and techniques for involving children in design activities. However, the approach is often slightly different when involving children with special needs, giving more weight to the coherence of activities, a clear structure in the sessions, multiple modalities of explanation, and the active participation of caregivers, teachers and therapists (Börjesson et al., 2015; Korte, 2018). When planning for involving children in design, instead of focusing on disabilities, there has been a recent push to focus on children's abilities (Wobbrock, 2017), resulting in the creation of design approaches for working with specific groups of children with diverse needs (e.g. Korte (2017), Wilson et al. (2019), Wilson, Sitbon et al. (2020)). Such approaches are designed to support PD with very specific groups of children who are currently overlooked by existing design approaches (e.g. minimally-verbal children on the autism spectrum) and could perhaps be used as the building blocks for design approaches with mixed and developmentally diverse design groups.

DPD presents a number of opportunities and challenges for the inclusion of children with special needs, and the forming of mixed ability design groups (summarised in Table 5). Firstly, DPD opens up the range of contexts and environments in which we can engage children in PD. Anecdotally, DPD work often takes place in the home. This means, when working with children with special needs, designers may have incidental access to parents or other family members who can act as supporters for children's involvement in DPD. This is supported by previous research such as Korte (2018), which identified the ways parents of young Deaf children could encourage and support their children's involvement and communication within PD sessions, but also highlighted that existing parent–child relationships embody the type of power imbalance so much of PD strives to minimise (discussed more broadly in Section 3.5). This is a complex area that deserves greater examination, as even the most supportive and well-meaning family members may be unfamiliar with supporting children in design or learning environments, and therefore may "take over" design interactions, or become a distraction themselves (Korte, 2017).

DPD provides increased opportunities for shaping design team formation, as designers are not limited to working with children from one specific school or geographic area. One approach is creating design teams representing mixed-ability groups deliberately. This could help to address Börjesson et al.'s call for increased diversity within design groups (Börjesson et al., 2015). Working with children of mixed abilities to design new technologies more closely mimics deployment in real world contexts, with mixed abilities within a user base. However, working with mixed ability groups also presents challenges, particularly in ensuring that DPD facilitators and supporters are able to meet the potentially diverse or even conflicting needs of all children involved. This can require very individualised accommodations — some of which may need to be dealt with at the child's end by caregivers or teachers, and many of which will require planning and action on behalf of DPD facilitators.

Another opportunity for design team formation is in forming mixed-age design teams. Working with children of different age groups can open opportunities in DPD with children with special needs and mixed ability groups. When working with a group of children with similar abilities and needs, older children may be able to help support younger children based on their own previous experiences. Workshop participants also speculated that, when working with mixed-ability and mixed-aged groups, age is likely to correlate with awareness of disabilities and needs, ranging from young children who may be unaware of disability; through to older children and teens who may be better able to make accommodations to support a child with special needs' involvement in PD.

3.4.1. Language and cultural differences

One of the strengths of DPD is that participants may be involved from all over the world, representing diverse experiences, languages and cultures. Hence, the language and cultural differences between and within countries must be acknowledged, respected and supported (Mainsah & Morrison, 2014). International and intercultural PD raises questions such as: How can we best support communication across languages and cultures? Could synchronous/asynchronous approaches to PD allow for translation to occur as ideas are shared around the world? Would pattern languages be potential solutions to communicate during

Table 5
Summary of opportunities and challenges in the theme Accessibility, Diversity and Inclusion.

Accessibility, Diversity and Inclusion	
Opportunities	Challenges
• Recruitment of design teams without limitations of geographic areas • Family members as a resource for supporting children's involvement in DPD • Recruitment of mixed groups — across ages and ability levels • Translation into multiple languages between asynchronous sessions	• Some family members may not be used to supporting children in DPD/ learning contexts • Very individualistic support required by some children

DPD? Should new pattern languages be developed with respect to cultural norms and language?

Translation of PD activities into the children's language/s can support cross-cultural PD, whether that translation is live (e.g. Korte (2012)); prepared in advance by local facilitators or researchers (e.g. Kam et al. (2006), Read et al. (2020)), or asynchronous, as enabled by asynchronous DPD. Training may be required to support local facilitators and researchers in PD practices if they are not PD researchers themselves (Kam et al., 2006; Read et al., 2020).

Other ways of facilitating design workshops with children who do not share a language or culture with the PD researchers/ designers were considered, such as language-free interactions between researchers and children (e.g. demonstrations (Antle, 2017; Kam et al., 2006; Korte, 2017; Wilson et al., 2019), smiley stickers and affirming indicators). Currently, Read et al. are developing materials for remote facilitation of design sessions in a different culture and language (Read et al., 2020).

Even when researchers and participants share a cultural context, establishing a dialog is not always straightforward — participants may feel they belong to different 'worlds' (i.e. may have different values, experiences and knowledge, and work with different concepts, resulting in language barriers of professional jargon) (Obendorf, Janneck, & Finck, 2009). Finlay, Allgar, Dearden, and McManus suggested using a pattern language – a meaningfully organised collection of "patterns", solutions to problems which occur often in a context – as a common reference for all stakeholders in PD (Finlay et al., 2002), which has proven fruitful also for the participation of children with special needs (Baykal & Eriksson, 2020; Eriksson, Baykal, Björk, & Torgersson, 2019), helping researchers not only to establish a common vocabulary, but also to involve children in the activities and to guide the analysis of observations. .

3.5. Power dynamics

PD has a long heritage of attempting to equalise power relations, with the aim of "giving voice" (although this metaphor is contentious (Wilson, McNaney et al., 2020)) to those who traditionally lack power in the development process. This requires addressing power imbalances inherent in the design process, and allowing and supporting the users of the technology to have agency in its development (Björgvinsson, Ehn, & Hillgren, 2010; Bratteteig & Wagner, 2012; Kensing & Greenbaum, 2013). It is not uncommon to encounter 'unequal power' (Franz, 2012) during collaborative design activities with children, such as some children coming to the co-design tasks with higher status than others (Van Mechelen, Gielen, vanden Abeele, Laenen, & Zaman, 2014). Within CCI, several authors report remediating asymmetrical power relationships between adults and children, e.g (Druin, 2002; Fails, Guha, & Druin, 2013; Guha, Druin, & Fails, 2013; Mazzone, Iivari, Tikkanen, Read, & Beale, 2010), including Walsh et al.'s work to create DisCo, a DPD tool to enact Cooperative Inquiry and break down power imbalances (Walsh et al., 2012). (See Table 6.)

What surfaced during the workshop was the need for the involvement of more adults in an online setting compared to an in-person setting for design activities. Apart from the facilitators, other adults such as parents, teachers, and family members may also be needed, mainly due to the access to technology and setting up the online environment. This increased involvement of adults may lead to a power imbalance within the activity, and an increased dependence of the children on the adults. In an online setting with an increased number of adults involved, the roles become blurred, which also affects the power dynamic e.g. should parents, teachers, or other family members act as facilitators or co-designers? The power imbalance affects the balance in participation and giving voice to ideas and designs.

The power dynamics within PD cannot be ignored, particularly when working with children and teens (Pitt & Davis, 2017). However, to cope with power imbalances, we look back to the roots of PD, and where attempts were made to visualise power, not neutralise it (Sjoberg, 1996). One recommendation could therefore be to make the power dynamics explicit and to clarify the roles of all the participants in a way that everybody understands and is comfortable with. On a positive note, while group interactions may be negatively affected by the changes in power dynamics due to the increased dependency on adults, there is more room for children's independence and privacy (e.g. through turning off camera and audio, or asynchronously working through activities at their own pace). (This section is summarized in Table 6)

3.6. Developing skills

It is widely suggested that involvement in technology design activities can help children develop skills such as reading, communication, collaboration, critical thinking, problem solving, design related skills and a reflective viewpoint towards technology (Barendregt, Bekker, Börjesson, Eriksson, & Torgersson, 2016a; Druin, 2005; Druin & Fast, 2002; Farber, Druin, Chipman, Julian, & Somashekhar, 2002; Guha, Druin, & Fails, 2010; Iversen et al., 2017; Knudtzon et al., 2003; Korte, Potter, & Nielsen, 2017). Such skill gain can particularly support children with special needs (Frauenberger, Good, & Keay-Bright, 2011). For example, a number of studies found that the involvement of children with autism in early design activities or initial prototype evaluation can help support their creativity (Benton & Johnson, 2013, 2015; Benton, Johnson, Ashwin, Brosnan, & Grawemeyer, 2012; Keay-Bright, 2007a), team work and social skills (Benton & Johnson, 2013, 2015; Benton et al., 2012; Keay-Bright, 2007a, 2007b; Piper, O'Brien, Morris, & Winograd, 2006).

Unfortunately, such findings are mostly secondary to the main aims of the research, and based on informal and incidental data (Guha et al., 2010) (with Korte et al. (2017) providing a rare exception). The impact of participation in technology design activities on skills development for children is difficult to measure empirically, because it may not be clear whether it is due to each child's participation or to external factors (Benton & Johnson, 2015; Korte et al., 2017; Vines et al., 2012). Moreover, it is affected by the child's degree of participation and role in the design

Table 6
Summary of opportunities and challenges in the theme Power Dynamics.

Power dynamics	
Opportunities	Challenges
• Privacy • Child independence	• Need for several more adults • Increased dependence on local adults, with pre-established power dynamics • Unclear adult roles

Table 7
Summary of opportunities and challenges in the theme Developing Skills.

Developing Skills	
Opportunities	Challenges
• Development of skills for some children through online interaction • Development of digital skills for children and parents/teachers through the use of online tools • Children learning how to express themselves and communicate ideas in an online environment	• Difficulties posed by online interaction to some children (see Tables 4 and 5) • Need to consider the accessibility of online tools

process, and it is difficult to determine if the effects will be short or long-term. This has led some authors to call for more targeted research and systematic investigation of such topics (Benton & Johnson, 2015; Brosnan, Parsons, Good, & Yuill, 2016; Guha et al., 2010).

Despite such criticisms, workshop participants highlighted the great potential of PD to support the development of skills with children. However, during PD, skills (e.g. communication, collaboration, problem solving) are likely to be developed as a result of the children's interaction with peers, researchers and designers (Guha et al., 2010). While this interaction is usually performed in-person, this is not possible during DPD, when the different parties are not (all) co-located. Workshop participants feared that, for many children, this could constitute a barrier to their skill development.

We see this concern as being connected to the challenges described in the themes "Participation in Online Environments" (Section 3.1) and "Sense of Connectedness/Togetherness" (Section 3.3). In particular, for many of people, in-person interaction feels more natural and comfortable, while online interaction hides numerous social cues like body language and gestures or, worse still, the possibility to see the person at all (if their camera is turned off), or to hear them (if their microphone is turned off). Moreover, online interaction adds the layer of technology and potential difficulties which often come alongside it, as well as the stress which can be associated with using technology. Finally, collaboration can be more difficult to manage in an online environment. Importantly, however, there are others for whom online interaction is advantageous. Some children feel motivated by the use of technology, are excited about using software tools that they do not have the opportunity to use otherwise, or are already used to technology and therefore find it familiar and less intimidating than face-to-face interaction. Online interaction can be beneficial for children who have difficulties with social interaction, or physical difficulties which make collaboration via a screen easier than using, for example, pencil and paper. This requires special attention to building accessible software for the particular needs of such children.

The use of technology during PD also helps develop new skills in both children and the adults supporting them (e.g.parents, teachers). In particular, in the current climate where most interaction is taking place online, the use of technology has increased and more and more people are developing digital skills. Previous work shows that parents are becoming more open to allowing their children to use technology and supporting them in doing so (Antle & Frauenberger, 2020), thus developing their children's digital skills and their own. Apart from using common day-to-day tools, like videoconferencing software, online PD and DPD provide opportunities for participants to use collaborative and design software which they may not be familiar with in advance, and which could also help them in other contexts (e.g. collaborating on a school project). While online interaction poses some challenges for children as discussed earlier, it is also an opportunity for them to develop the way they express themselves and communicate ideas such that they can be interpreted by others. This could be made explicit during an online PD session by, for example, including training or giving children some time to practice sharing and interpreting each other's design ideas before the main part of the study. To this end, Barendregt et al. suggested that designers should formulate individual learning goals for children participating in PD (Barendregt et al., 2016a). (This section is summarized in Table 7.)

Further research should seek to examine explicitly questions such as: How to conduct PD training for adults and children to equip them with the necessary digital skills? How to support children maintain/generalise the skills acquired during the studies? What are those skills that need more attention for particular groups of children? How to support skills development in PD team proxies?

3.7. Administration, pragmatics and logistics

Children have been involved in the design of technologies at varying levels of involvement (Barendregt, Bekker, Börjesson, Eriksson, & Torgersson, 2016b; Druin, 2002) and many methods have been proposed, utilised, and adapted to varied contexts (Fails et al., 2013). That said, more methods (or adaptations of methods) are needed to more fully accommodate online design sessions. While DPD has been previously proposed and explored (Walsh et al., 2012; Walsh & Foss, 2015), there are many ways of further exploring and expanding online PD with children.

This was apparent in the workshop, where the administration and logistical pragmatics were frequently noted as rife with challenges and ripe for opportunities to tackle. Topics within this area included ramifications on recruitment, planning, facilitating and conducting DPD sessions. (See Table 8.)

3.7.1. Recruitment

It can be difficult to recruit children for DPD if schools are not open or accepting research projects. While there is the potential to broaden participation to those that may be unable to consistently travel to a central location for face-to-face participatory design sessions, there are still access issues to technology access (commonly referred to as the digital divide) that can hinder this broader participation. Economic barriers to participation include

Table 8
Summary of opportunities and challenges in the theme Administration, Pragmatics and Logistics.

Administration, Pragmatics and Logistics	
Opportunities	Challenges
• Potentially larger recruitment pool (anyone online) • Less travel time (for facilitators and participants) • New ways of collaborating online	• Participant recruitment • Digital divide still exists • Tech setup and support • Need for additional adult help (parental and facilitator intervention)

device access, consistent broadband access, familiarity of technologies (for parents and children), etc. These have been starkly highlighted recently as the COVID-19 pandemic has forced many schooling activities to go online.

3.7.2. Planning

Planning and scheduling DPD sessions can be more challenging than in a face-to-face context. Designing in a distributed manner is a slower process. As expressed by the workshop participants, it simply takes more time to accomplish similar kinds of design activities. This requires facilitators and planners to consider the balance between synchronous and asynchronous activities, and when and how synchronous activities are coordinated. While using DPD, one must also take into consideration whether ideas and designs created by previous child participants can be used as input for new child participants and how that will be done. Using physical artifacts has many advantages for active, collaborative, iterative and constructionist co-design activities, but sharing those artifacts and allowing others to build on them is much harder with DPD. The initiation of the design activity needs to be thought through such that it motivates children. Trained or experienced facilitators (some called them 'champions') are desirable to encourage children to interact. How sessions are conducted also impacts recruitment as some may have preferences for face-to-face versus online interaction.

3.7.3. Facilitation

There is a high degree of dependency on adults as facilitators, particularly in online PD settings. For example, in our workshop, we utilised an asynchronous distributed PD approach where children in a class created ideas, which they later presented and shared with adult researchers. This particular approach required that the teacher facilitate the children's design activities. There are some advantages and disadvantages to this approach, including the advantage of children's familiarity with their teacher; and the disadvantage that there is a traditional power dynamic between teachers and children that sometimes conflicts with the goals of co-design activities. Admittedly, there are many other ways of conducting distributed or online PD but due to the constraints of the workshop, this particular model fitted us well.

Some of the organisers and participants in the workshop had engaged in online PD and DPD in synchronous sessions and noted that additional adult facilitation made it easier to conduct the design sessions (Bonsignore, 2020; Fails et al., 2020). One of the research groups found it best to have a 1:2 adult:child ratio to facilitate DPD (Fails et al., 2020). This represents a distinct challenge for DPD; for example, a 1:2 ratio would make it challenging to scale up to the envisioned "World's Largest PD Project" that the workshop was striving to plan. Additionally, while synchronous design activities can have advantages, there is a need to leverage asynchronous approaches in order to support design with stakeholders in various time zones.

3.7.4. Conduct during sessions

There are many issues related to how children and adults should conduct themselves during design sessions. This theme is related to all other themes apart from Recruitment. Of particular note was the importance of facilitation to encourage children to collaboratively build on each others' ideas, prioritise and negotiate ideas, and allow periods of silence to give children space to think and work. There is a balance to be had between facilitating and keeping children engaged, and providing silence and time to allow the ideas to germinate and manifest themselves through the design activities.

4. Discussion

In this section, we will discuss the lessons learned from the workshop and main considerations for conducting DPD.

4.1. Widening participation and inclusion through DPD

Our workshop discussions led to the conclusion that DPD has the potential to extend participation and inclusion in the PD process by addressing many challenges posed to PD by COVID-19. Whether the design process is synchronous or asynchronous, online or offline, or any possible hybrid of these approaches, it became clear that the switch from in-person to remote participation can increase both the diversity and the number people involved in the design process, as participant location is not a barrier within DPD. Moreover, DPD inherently facilitates social distancing, which not only prevents the risks associated with a global pandemic, but also has a positive impact on the participants with difficulties in social interaction. When conducted online, DPD benefits from technology capabilities, allowing flexibility for synchronous and asynchronous sessions. Asynchronous sessions can permit people from different time zones to collaborate, while also offering participants the opportunity to work at their own pace.

Technology supports diverse modalities of expression, which may accommodate diverse needs and support participants to maximise their contribution to the design process (Wilson, Sitbon et al., 2020). For instance, Constantin and Hourcade designed a prototype tool to empower children with autism to express their creativity during idea generation stage of PD. The tool, acting as an interface between PD researchers/designers and children, creates the social distancing which helps reduce children's anxiety and unlock creativity (Constantin & Hourcade, 2018). Similarly, Antle and Frauenberger reported that a private chat function may reduce social pressure and offer a new channel for expression which does not exist in traditional in-person PD (Antle & Frauenberger, 2020).

There are multiple benefits to online PD and DPD, which have a positive impact on participation and inclusion in the PD process:

- increased privacy and independence (e.g. participants can turn off their video camera and/or microphone);
- use of technology as a means of increasing and maintaining engagement;
- use of breakout room functions to facilitate transitions from large to small group activities;
- documentation of ideas and traceability of ownership of ideas;
- translation into multiple languages between sessions (especially in asynchronous sessions);

- use of technology to avoid disruptions (e.g. by muting participants);
- wide range of tools for online collaboration; and
- potential to recruit for diversity and mixed ability groups.

However, there are still a number of challenges which need to be addressed in online PD and DPD in relation to participation and inclusion:

- The multitude of online tools – few of which were designed for children to use – makes it difficult to choose appropriate technologies).
- Artificial interaction and barriers to recognising non-verbal social cues in the online environment have an impact on social cohesion and hence on inclusion and participation.
- Limited access to technology based on socio-economic status or country of residence impacts participation and inclusion. The greatest barrier to increased participation is the increased reliance on technologies, which can disadvantage children from low socio-economic backgrounds, who already face the challenges of the digital divide. Thus, the digital divide must be addressed in order to establish equal opportunity for participation in DPD for people all over the world (Antle & Frauenberger, 2020).
- The lack of ambient information makes it difficult to ensure equitable engagement.
- DPD requires sensitivity towards cultural differences which need to be respected and supported.

Non-technological alternatives for DPD are still in a premature stage. Remote facilitation of the design sessions through PD packages and design teams proxies has been considered by PD researchers (Read et al., 2020), but more research is required. It may be worth revisiting the ideas of cultural probes (Gaver et al., 1999) to inspect how they could intersect with online PD or DPD.

4.2. Access to new PD participants and supporters

As previously mentioned, online PD and DPD offer potential access to more participants, who otherwise may have not been considered in a traditional in-person PD (e.g family members such as parents and siblings, or people who are not geographically co-located). While this is an advantage, there are a series of challenges which need careful examination:

- Although family members are potential supporters of the child participants, they may need to be trained for the PD sessions, both in terms of technology to be used, and PD norms. Digital literacy differences between parents, but also between children may hinder the PD activities if these are to be online. Both adults and children may also need to be trained for using the technology.
- Some family members could become distractors during online PD sessions (e.g. siblings).
- There is a strong need to define the roles of different participants (e.g. parents, siblings).
- It is difficult to balance the power, particularly between adults and children in home settings.
- DPD may require a high adult-to-child ratio (i.e. 1:2 (Fails et al., 2020))
- There may be increased dependence on adults for technology access.
- Some children require personalised support which could create inconsistency across participants.

4.3. Need for more innovative PD methods and tools

While DPD comes with more opportunities for overcoming barriers for participation and more resources, the increased diversity of participants as well as the change of social interaction from in-person to online/remote requires new innovative methods and tools. First, the online communication tools used during pandemic (e.g. Teams, Zoom) are not specifically designed for PD or PD with children. More research is needed to design and develop appropriate child-friendly communication tools and platforms for both synchronous and asynchronous PD sessions. Special attention should be paid to match the technological affordances to the DPD goals.

We believe that there is a strong need for future studies focused on designing innovative (technology-based) methods and tools that address the challenges identified in our discussion. Traditional PD methods could serve as a starting point as in the DisCo project (Walsh et al., 2012) which extended the Layered Elaboration method (Walsh et al., 2010). PD researchers could consider new innovative technologies, such as Machine Learning (ML) which have been increasingly mapped to Human–Computer Interaction (Yang, Banovic, & Zimmerman, 2018). For example, within ML, technology topics such as crowdsourcing (Constantin, Alexandru, & Dragomir, 2019) should be explored as they could be valuable aids for addressing challenges such as maintaining engagement and supporting children to stay on task. Artificial Intelligence tools could be developed with ML models to support the facilitation and analysis of online PD sessions.

As mentioned before, DPD should not be limited to the online space. PD across geographical areas can also be conducted using non-technological tools or a hybrid approach (i.e a combination of online and offline methods). Following their experience in Malaysia, Read et al. engaged in creating PD packages to be delivered to the proxies who could conduct the PD sessions without a PD researcher/designer presence. They proposed that these packages should be designed also for no-technology settings, and should incorporate language-free interaction assets (Read et al., 2020). These ideas could help to overcome the "digital divide" problem (Antle & Frauenberger, 2020).

4.4. New opportunities for skills development

There is a general agreement that PD has a considerable value in supporting the participants to develop their skills, such as creativity, problem solving or even design skills (Barendregt et al., 2016a; Druin, 2005; Druin & Fast, 2002; Farber et al., 2002; Guha et al., 2010; Iversen et al., 2017; Knudtzon et al., 2003; Korte et al., 2017). While the remote interactions of DPD raise questions as to the efficacy of such skill development, it also opens the potential for children and adults to gain new technology-related skills, which has become an urgent need during the pandemic. Therefore, given the opportunity created by this shift, it is more important now than ever before that PD researchers pay more attention to skills development when facilitating sessions with children, as Antle and Frauenberger emphasised (Antle & Frauenberger, 2020). Such skill gains could then be used as a "selling point" to make involvement in DPD projects appeal to parents — who have gained an appreciation for having their children involved in studies during COVID-19 (Antle & Frauenberger, 2020), as a way to gain technology skills.

4.5. Expecting the unexpected

PD is an intensive and difficult process, in which unexpected situations can arise at any stage (Constantin, Korte et al., 2019). In DPD, unexpected situations could arise with a higher probability

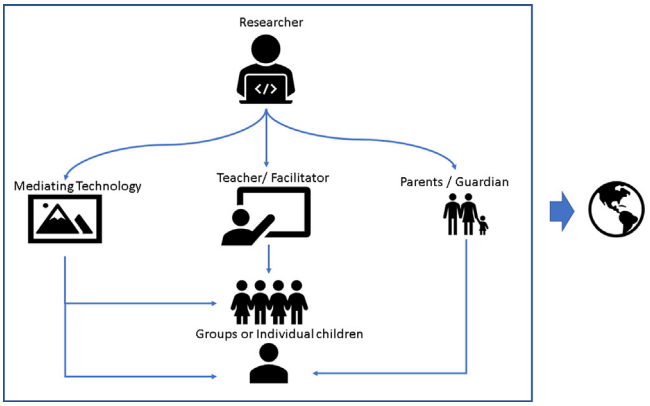

Fig. 1. Distributing *process* in DPD with children.

and impact than those which occur in the traditional in-person PD, as it adds more dimensions, such as geographical areas, cross-language and culture interactions, and new incidental participants. This requires extra attention, and possibly contingency planning, around issues such as:

- technology hiccups;
- technical malfunctions (e.g. Read et al. (2020));
- unexpected difficulties with technology installation and use;
- unexpected ethical considerations (e.g. situational or 'in-action ethics' (Van Mechelen, Baykal, Dindler, Eriksson, & Iversen, 2020)); and
- resource management (e.g. identifying the length, number and type of sessions).

Therefore, when planning and conducting DPD, researchers need to identify possible solutions and alternatives for potential unexpected situations and failures. In addition, more patience is required, and more time should be allocated for activities (Fails et al., 2020).

4.6. Modeling distributed participatory design with children

It is clear that online PD is increasingly being adopted by PD researchers, because it enables people who are not co-located to participate in and contribute to a project (physical distribution) (Constantin et al., 2020; Danielsson, Naghsh, Gumm, & Warr, 2008; Walsh et al., 2012). In spite of coming with its own difficulties and barriers (e.g. communication and knowledge sharing, technology requirements), we strongly believe that online PD should be encouraged, especially because it has the potential to increase inclusion across cultures, languages and abilities.

Distributed PD can be thought of as an extension of online PD, but it can also be considered as an instance of online PD. We adopt a global perspective, suggesting that PD will, over time, become a distributed (Zaphiris, Zacharia, & Rajasekaran, 2004), and at times asynchronous practice. We expect it to rely heavily on online tools and online presence but also acknowledge that it may be possible without any online elements.

When considering whether PD is distributed or not, it can be helpful to think about the use of the term *distributed* and to consider what this might mean. We posit that it applies in two senses — first to the distribution of a PD *process* and secondly to the distribution of a design *effort*. We offer a visualisation of our thinking in Fig. 1.

This model demonstrates how the PD *process* can be packaged and distributed by the researcher. In this model the researcher can gain access to children through three mediums: technology,

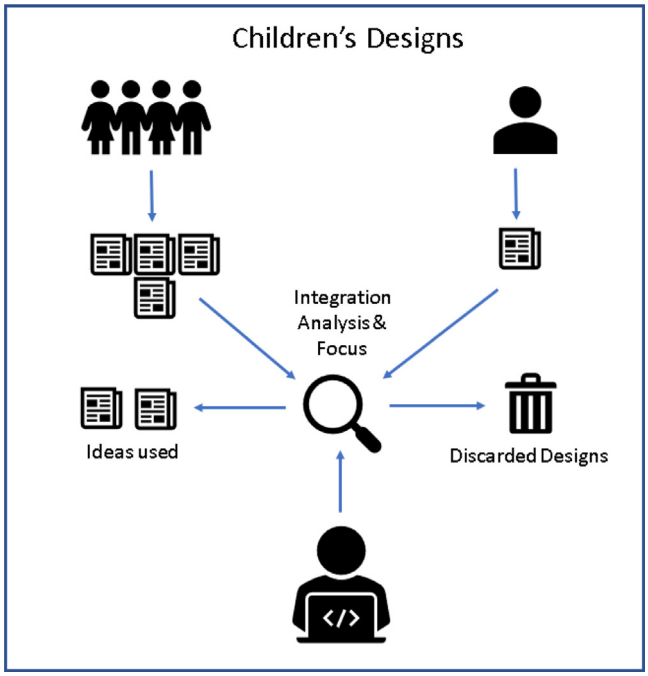

Fig. 2. Design time versus contribution (ideas used vs discarded ideas) in participatory design with children.

via a teacher or facilitator acting as a proxy, or via the child's parents or guardians. The outcomes of the design session are going to be significantly influenced by this layer. Further work is required to understand how to effectively package material for distribution within these three mediums. For example different materials may need to be produced to be used with a parent or guardian within a home context in comparison to a school. Parents and teachers may not understand the design space in which they are being asked to facilitate the session. This may cause anxiety or reluctance to participate, impacting on both the experience of the children and the final output. Although this is not intended to be a definitive model of all permutations of how to facilitate a DPD session, it aims to invoke a critical discourse of the process of working remotely with children.

The other aspect of DPD, the distribution of effort towards solving a design problem, is in need of considerable further study. A tension exists in IDC and CCI as to the ethics of the inclusion of children in design activities within the context of the value of their contribution versus the time they spend on the effort, see Fig. 2.

It is not acceptable, for example, to engage with thousands of children around the world without considering what their contribution brings. This contribution might be a cultural emphasis, a needs emphasis, or an age-related emphasis, or it might be a piece of the whole - e.g. the interface look and feel, the reward mechanisms for a game, or the characters. Distributing the design effort, necessary as the groups of children included become large, is a challenge for DPD that needs considerable further work.

Within the model further work is required to understand how this distributed process impacts the children's experience and understanding of the design process. The children may not understand their role or contribution to the overall project. In addition they may struggle with ideation, without the help of their peers or the researcher. This may result in them disengaging from the process or not understanding their true value in the design process.

Table 9
Key considerations of selecting a PD approach.

When to choose which PD approach?				
In-person PD	Online PD or DPD	Offline DPD	Asynchronous DPD	Hybrid DPD
The great strength of face-to-face PD is designing with colocated participants.	Online PD and DPD provide access to participants and communities who cannot colocate.	Offline DPD should be examined for its potential to bridge the digital divide.	Asynchronous DPD allows for more time, supporting translation or processing of materials, and extra time for participants' self-paced work.	Hybrid DPD could support involvement of participants across the digital divide *and* harness advantages of technology-mediated PD. However, different kinds of involvement may be unequal.

5. Conclusion and future work

Our workshop revealed a series of opportunities for PD with children during a global pandemic and raised a number of questions which can serve as drivers for future directions of research. The unexpected adaptation of our IDC 2020 workshop from in-person to online due to COVID-19 worked as an impetus to motivate us to reflect on our experiences. The workshop participants – PD researchers from all over the world – shared their experiences and brainstormed new potential solutions for DPD with children. We conclude that, in spite of its challenges, DPD provides new opportunities for removing participation and inclusion barriers, access to new PD resources, and opportunities for skills development. We identified directions for new method development and raised methodological and practical questions to be addressed by PD researchers. Three future directions appeared to be prominent:

- Designing and developing innovative DPD methods and tools. New innovative methods and tools which incorporate underutilised technologies, including machine learning (ML), should also be considered (see Section 4.3).
- Defining or shaping the roles within DPD. It is crucial to understand the roles of the designers and other participants within DPD, and to train participants, in order to reduce unexpected situations and ensure consistency.
- Developing strategies for offline and hybrid DPD. Non-technological alternatives are important in overcoming the digital divide, however, where possible, hybrid DPD strategies could offer more flexibility (e.g. more diverse forms of expression and support). Table 9 highlights some of the key considerations which may be relevant in selecting between online, offline and hybrid PD approaches; however, further research should explicitly examine the strengths of each mode.

We hope that this article will inspire researchers to drive their attention towards addressing DPD challenges and opportunities.

6. Selection and participation

The workshop included a live PD design session with children. One of the workshop organisers had worked before with the teachers and children in a school in UK. The participants were recruited by that organiser through the teachers in that school. All children provided informed consent, and their parents were notified about the study. On the morning of the workshop, a design brief was given online by one of the workshop organisers to a group of children in that school which remained open during the pandemic for the children of key workers. Children were told that they could withdraw at any point. The children then had some time to work on the task, using paper and pencils, and the results from the design brief were later presented to the workshop participants either by children themselves (via Zoom video conferencing), or by the teacher in the cases where the children preferred that way. Participants' personal data was kept confidential, and their answers treated anonymously.

Declaration of competing interest

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

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