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Conference paper

Universal Access in Human-Computer Interaction
17th International Conference, UAHCI 2023, Held as Part of the 25th HCI International Conference, HCII 2023, Copenhagen, Denmark, July 23–28, 2023
Proceedings, Part I, pp. 171–184
Published version: https://doi.org/10.1007/978-3-031-35681-0_11

Design With And For Children: The challenge of inclusivity

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Abstract. In this position paper we will discuss the challenges of inclusivity when involving children in collaborative design. The HCI community is strongly committed to promoting inclusive user studies as the way to foster a better understanding of users and their needs. Similarly, researchers in Child Computer Interaction (CCI) are actively promoting the direct engagement of young users. However, inclusivity still proves to be a challenge, with the involvement of parents and guardians being the first step to take. Discussion will be driven by literature in CCI as well as by our experience running a project involving very young children in the co-design of technology to support the development of pre-reading skills. We will present the concept of child as protagonist as championed by recent literature and explore whether and how the community has embraced it over time. We will look at different domains, context and age groups as starting point for a systematic analysis of the available approaches to reach out and be inclusive when running user studies involving children. Our experience with the recruitment of young children and the struggle to make our study inclusive will provide an insight into a dimension seldomly discussed in literature and will enable us to elaborate on open issues for the CCI as well as the HCI communities to reflect on.

Keywords: children · codesign · collaborative design · inclusivity

1 Introduction

In recent years, children have started using technology earlier and earlier, with children as young as 3 or 4 already using tablets and computers, both for education and for entertainment. However, children are not independent in their use of technology, which strongly depends on the opinions of their parents, caregivers and teachers. Therefore, researchers should aim to involve both children and adults as stakeholders in the design of technology for children, as well as experts in the fields of education and child psychology.

Nevertheless, children's involvement should not be seen as subordinate to the adults, and instead they should be at the center of the design process, taking a protagonist role as championed by Iversen et al. [19].

In this paper, we will first outline the most relevant research on how to involve children, parents and other adult stakeholders in the design of new technology;

then we will write about our own experience in involving children in co-design sessions, both at school and in an extra-curricular setting, detailing our insights and observations, but also the struggles and challenges that we faced in our work. Finally, we will draw our conclusions and provide points of reflections for the community.

2 Related Work

In this section, we will discuss the most relevant research on involving users in design, then specifically on involving children, parents and guardians, outlining both the theory and the methods used in the research.

2.1 Involving users in design

Participatory design originated in Scandinavia in the 1970s, and it was originally meant as a way to involve factory workers in the research and design of new software for their workplace [22]; as such, it concerned the idea of democratising work [3]. However, it quickly grew and now its concepts are used throughout the world, as it has shown to have many benefits: for example, involving users in the design process has a positive effect on both the success of the system and the satisfaction of its users [20]. The process of co-design also has inherent ethical qualities, as users can express and share their experiences [35]. It can be seen as an empowering process, in which users are involved in the design of products that will raise their quality of life [17].

2.2 Designing with and for children

While in the past co-designing was mainly performed with adult users, in the last decades children have also started being involved in the design of new technology, first as testers, then as informants and finally, as design partners in their own right [9]. According to Read et al. (2002) [27], the ideal age for collaborative design is between 7 and 10 years old, as children of that age have a good capacity of abstraction and reflection, but they are still very imaginative, and they lack prejudices and preconceptions. In this age range, both brainstorming and prototyping work well as design methods: while children uncover a higher number of design ideas when prototyping, they provide more detailed criteria when brainstorming [31]. Many methods to evaluate technology with children, such as the Fun Toolkit, have also been developed for older children, at least 7 years old [28].

Some techniques developed for older children, such as the Cooperative Inquiry([8], have been successfully adapted for younger children with some changes, such as allowing the children to draw their ideas instead of writing them down and working in smaller groups [10]. Both Superti et al. (2020) [37] and Farber et al. (2002) [10] emphasize that children work better in smaller groups. This is also

supported by [2], who goes beyond that to present evidence that younger children, aged 4 to 5 years old, have the most difficulty in working collaboratively, and work better in pairs.

Other techniques have been proven to be useful with older preschoolers, but still present challenges with children on the younger side of this age range: for example, Barendregt & Bekker (2013) [1] used the drawing intervention method to elicit design ideas with children aged 4 to 7 years old, and found that the younger children found it hard to collaborate, and had difficulty using drawings to communicate design ideas. This was also true for Hiniker et al. (2017) [14], who used *Fictional Inquiry* and *Comicboarding*, techniques developed to elicit insights from adults users, with children aged 4 to 6 years old; while 5 and 6 years old were able to successfully generate design ideas, 4 years old children had more difficulties in doing so. However, younger children still participated enthusiastically, suggesting that with more adult facilitation, they could participate fully in the design process. This is also confirmed by Farber et al. (2002) [10], who note "More adult facilitation" as one of the changes to design methods needed to involve younger children. However, Marco et al. (2013) [21] report that less structured sessions, that required a small amount of instructions to be given to children, tended to elicit more reliable and valuable data for researchers.

There are also many design methods developed specifically for younger children. For instance, as envisioned by Iversen et al. [19] and following an approach centred on constructive play practice, aimed at creating a story-line and establishing a cooperative process, children can become protagonists in the design process [33]. Another example is *Mixing Ideas* [12] that has been used to foster collaboration among young children. A technique called *Play-based design* has also been developed for younger children, involving make-believe play activities with an adult facilitator [37].

Even though collaborative design has made progress toward inclusivity by involving kids of a wider age range than before, it is still difficult to successfully involve younger kids, and there is still much research to be done in this area. This research is crucial because kids are starting to use technology at a younger age than ever, and as a result, they should be involved in the design of the technology they use.

2.3 The role of parents

Parents' perspectives and insights are important in the design of technology for children, as they are not yet independent users. As a consequence, many studies have explicitly looked for parental feedback into their own needs and perspectives, concerning for example the safety and suitability aspect and the use of technology for learning. Some studies have also compared parents' and children's perspectives, or considered activities shared by parents and children.

Parents' perspective on the safety and suitability of technology Sobel et al. (2017) [32] involved 87 adult guardians (parents and other family members,

70% female) with surveys and interviews to gather insight on their perception of location-based mobile games and specifically *Pokemon GO*. While adults valued how playing with *Pokemon GO* led to an increase in exercise and outdoor time, they had concerns about safety in the real-world environment.

Quayumm et al. (2021) [26] conducted semi-structured interviews with 25 parents (8 fathers and 17 mothers) of children aged 10 to 15 on the topic of children's cybersecurity risks, with parents believing that children should both know about security risks and be able to think critically and be skeptical of what they find on the internet.

Sun et al. (2021) [36] who interviewed 23 parents of children aged 1 to 11 years old to gather insight on their perception of physical and digital safety risks that smart home technology pose for their children, finding that parents encountered unanticipated risks when introducing smart home technology into their homes, and that as children grow up, the perceived risks shift from physical to digital safety.

However, the perspectives on technology can vary even within a family, with set of parents having different ideas and perspectives. Derix and Leong (2020) [7] used the probes method to gather insight from 17 participants from 8 families with at least one children under the age of 12. The 8 family sets were composed of 6 families with a mother and father, one family with two mothers, and one family where a mother, an aunt and a grandmother shared parenting responsibilities. In most families, one parents engaged with the probes in a most comprehensive way than the other(s), and when collective responses to the probes were compared with individual ones, in many cases the collective response coincided with the response from the parent who had engaged more with the probes, who was also the parents with more domestic and childcare responsibilities.

Parents' perspectives on technology for learning Hightower et al. (2019) [13] conducted semi-structured interviews with 12 mothers of children aged 3 to 5.5 years old to examine their beliefs about the role of media in their children's STEM learning, with the aim of identifying areas where parents need the help of technology in supporting their children's learning. Parents reporting using media as a support tool for STEM learning, with the belief that media should be used as a reinforcement of concepts that had already been introduced to the children, while also expressing concern about finding appropriate media for their children's age and educational level.

Yu et al. (2020) [39] interviewed parents who had obtained coding kits for their children to use at home, to understand what they expected from their children's use of the kits, what roles would the parents play, and if they had any concerns about the activity. The participants were 18 parents - 13 mothers and 5 fathers - of children aged 3 to 9 years old. While parents perceived the benefits of coding kits, they also had concerns such as having limited programming knowledge to help their children.

Solyst et al. (2022) [34] ran a survey involving 133 parents - 105 mothers and 21 fathers - of children in middle and high school. The survey asked about

parents' perception of computer science, and how important they felt it was for their children to learn computer science. The results of the survey shows that parents' first perception of computer science includes using devices and apps, instead of designing and developing them, and when this misconception is corrected, parents feel that the importance of computer science declines. While only few participants expressed skepticism about computer science, and most believed that their children are capable of learning it, a limited number of parents actively encourage children to learn computer science, with parents more familiar with computer science more likely to encourage children to follow the same path.

Involving both parents and children in design Several studies have involved both parents and children, on various levels, in the design of technology. Horton and Read (2012) [16] surveyed 12 parents and their children aged 6 to 10 years old, with parents being asked what technology they had in their home, who owned or whether it was shared, and whether the child was allowed to use it. Children were only asked what technology they had at home. According to the results of the survey, children can accurately report on what technology they have at home, however they do not always associate the items they have at home with the ones their parents report they have access to.

Oygür et al. (2021) [23] also compared children's and parents' perspectives, interviewing 17 families with children aged between 7 and 12 years old, who regularly used wearable devices to track their physical activities. The interviews involved 18 parents, of which 15 were mothers and 3 were fathers. This study showed that children and parents value different aspects and have different motivations in using wearables: while parents' motivation primarily involve their children's health and well-being, children are more concerned with entertainment and accomplishment in reaching their goals.

Sadka and Zuckerman (2017) [29] involved both parents and children in a co-making activity at home, showing their results in a two dimensional scale with two metrics: parent initiative - with low initiative corresponding to the "mentor" role and parent as peer and high initiative corresponding to the "peer" role - and attention, a prerequisite for a successful co-making activity and for both peer and mentor role, with the latter being preferable as more focused on the child's learning process than on the completion of the activity.

Hoffman et al. (2013) [15] performed a 6-weeks long study to evaluate an in-car game with six families with children aged 10 to 12 years old, finding that adults and children have different expectations and desires, while parents were also concerned that introducing a game during car journeys might shift their children's focus towards the screen, detaching them from the family and the environment.

Yip et al. (2016) [38] involved 16 families - parents and children - recruited through a local middle school in a series of 9 co-design sessions over 10 months, using the Cooperative Enquiry method. They noted the different ways in which parents engaged with the co-design activity: both passively and supportively, acting as advocates for their children, and as parental managers. They also

noted the concerns that the parents had with the co-design activity, such as the fear that they would take time away from their children's school work and the sacrifices that they met to come to the sessions.

Garg and Sengupta (2020) [11] conducted three collaborative design sessions with children, with the third and final session including parents as design companions. During this sessions, the parents elaborated on their children's designs by adding features related to social engagement, parental controls and privacy.

Overall, it is clear that the majority of studies involving parents are relatively recent and that mothers make up the majority of the parents in these studies. However, there is a significant bias because participation in these studies is always voluntary and because the parents who take part are also the parents who are willing to use technology with their children. Nevertheless, parental worries about privacy, digital safety, and control are recurring themes that we can find throughout the literature.

2.4 The role of teachers

Involving teachers in the design of technology can have a positive effect on learning outcomes [6]and in them taking ownership and agency not only in the design, but also in the dissemination of the innovation [25].

Teachers can also be involved as facilitators in evaluation activities, showing that they are able to identify similar usability problems as the researchers with very little training [24], even if they are seen as authority figures by students - while researchers are not.

Moreover, teachers expect and experience different user gains when participating in co-design activities in the classroom, both for themselves and for the children [4]. For example, they expect that both they and their students will learn more about technology, and that the children will have fun. However, as teachers often have little time for these activities, Börjesson et al. [4] also suggests to organise design activities as part of teachers' professional development curriculum, to make it easier for them to participate.

This was in fact Celeptoku et al. (2020)'s approach [5], as they organised a professional development workshop in which 22 teachers learned about computer science and created lessons plans to integrate it in the classroom. The workshop allowed teachers to see computer science's potential to teach critical thinking and to prepare students for their future, while at the same time allowing researchers to delve into teachers' perceptions and expectations of the role computer science can play in the classroom.

Teachers' needs and preferences for digital activities to be used in schools are crucial to ensure that the activities are carried out in the classrooms, as when teachers have a positive attitude towards an innovation, they tend to use it more in their class [30]: for example, teachers prefer games that promote learning and align well with the school curriculum, while at the same time improving soft skills and increasing engagement with computers [18].

3 Our Experience

During the course of our project, we conducted several different user studies, ranging from semi-structured interviews with teachers, parents and experts to evaluations and collaborative design sessions with children, held both in schools and in extracurricular settings.

In this section, we will outline the methods we used to recruit participants, organise the studies and analyse the data, the challenges we encountered and the insight that we were able to gather.

3.1 Working with schools

We started working with preschools in 2019, partnering with a private preschool in Lugano to conduct an user study with children aged 3 to 6 years old, who would be evaluating a reading app on a tablet. In Switzerland, preschool is a form of non-compulsory education, however it still has a country-mandated curriculum to follow. Because of this, we decided to partner with a private school that offered extended hours for working parents, and as such had the time for activities that went beyond the school curriculum.

While the headmistress of the school was enthusiastic about our project, the teachers were hesitant, as most of them were reluctant to use technology in the classroom - for example, while every classroom was equipped with an interactive whiteboard, only the English teacher used it. Other teachers commented that children already got significant screen time at home, and did not see the need to also introduce technology at school.

We prepared consent forms for the parents, which included a presentation of our project, a brief survey on their children's reading habits, and an informed consent that the parent would have to sign. We also included our contact numbers so that parents who had questions could be able to call us.

While the majority of parents signed the consent form, some parents did not want their children to participate in the activity, while others called us with concerns and questions.

Performing our user study in a school had several tangible advantages: for example, we were able to have individual time with each child, while the other children went on with their activities with the teacher; furthermore, teachers were able to choose the best times in the day for us to perform our study - when the children were neither too tired or too excited - and they also advised us on each child's individual personality and mood.

On the other hand, we had to schedule our study in the days when teachers had time for us, since the activity we offered was considered optional and as such should not interfere with school activities.

After the 2020 COVID-19 pandemic, we tried to resume our work with schools, and we were able to conduct semi-structured interviews with preschool teachers as a way to understand how their perspective on technology in school had shifted.

However, both during and after the closures teachers had a considerably increased workload, and as such we were not able to conduct any more co-design sessions or user studies within the school.

It should be noted that we also tried to partner with the public schools in the city area, as we believed that this would have allowed us to interact with a more diverse population of children. However, as mentioned before public school in Switzerland have significant oversight by the cantonal authorities, and as such it is more difficult for them to find the time to perform activities that are not in the curriculum. While we were able to secure a semi-structured interview with a teacher who had been in charge of online learning during the school closures, we were unable to follow up with any school visits.

3.2 Designing in a non-school context

During our project, we also conducted user studies in non-school settings, mainly the university and a local children's library.

Since our university offers a week-long summer camp for children of employees, we decided to run a co-design session during the camp, using drawings as a method to elicit children's design ideas.

However, this choice posed many logistical challenges. First, it was necessary to obtain permission from the Ethics Committee together with approval of the legal office of the university, and then parents had to sign an informed consent. Since the camp schedule was tightly packed, and the camp participants were of mixed age - with several children older than the age range in which we were interested - we had to negotiate with the camp entertainers to find a time and a place that were suitable for everyone, as well on relying on them to provide an alternative activity for older children during the same time frame. While in the end we were able to run the activity, since we only had one session with children with whom we were not familiar, we only obtained limited insight.

We also partnered with a local children's library to involve children in a series of collaborative design sessions to inform the design of technology to help children foster pre-reading skills.

The library staff was enthusiastic to help, and circulated the information about our project and the consent form through the library's mailing list, composed of parents who are regular users of the library.

We were able to conduct two separate sets of sessions, involving more than 15 children in total, using a separate space that was also provided to us by the library.

Partnering with the library had many advantages for us: it was a known entity with which many parents were already familiar, and we could rely on the mailing list to circulate information about the project. By running a study over several weeks, we were able to build a relationship with the children, which allowed us to gain significant insight and generate interesting design ideas. When we ran our second set of co-design sessions, several children who had participated in the first set also signed up.

However, there were also some disadvantages: first, as the children were recruited through the library's mailing list, there was a selection bias in the children who participated in the study, as they were already familiar and interested in books and reading, and came from families who also valued reading.

Since we ran the activity at the end of the school day, children were often tired or excited, and it was difficult for them to focus on activities such as reading. While we did not want to be seen as authority figures, we strove to build a relationship with each child, which allowed us to run the activity more smoothly. We valued communication with the parents - some of whom were curious about our project and asked many questions - but we also felt that most parents did not really care about the specifics of the project, thinking of our user study as "another activity organised by the library", which meant that they had a hour in which they could run errands while someone else minded their children. This led to problems such as parents not telling us when their children would be absent due to illness, or when they wanted to completely withdraw from the study, and parents often being late bringing their children to the library, which cut into our already scarce time with them.

Overall, the support of the library was crucial to the success of the study, as they supplied us with projectors, pillows for the children and facilities that allowed us to run our study as smoothly as possible.

3.3 Ethical considerations

As mentioned in the description of our studies we engaged with the necessary procedures to obtain ethical approval from our university as well as dealt with specific requirements as issued by the institutions hosting the studies. Therefore, we carefully described our study so that parents, guardians, as well as educators could get a clear picture of the type of involvement required from participants. We made sure the scope and objectives of our research were explicitly stated, and the same was for details on how and where gathered data was going to be stored and whether these would be shared with other members of the research community. We then paid particular care in explaining children the purpose of our visits and the kind of activity we would like to engage them with while also clarifying how participation was on voluntary base. It was also important for us that children felt at all times safe and comfortable, and never excluded from any of the proposed activities which we adapted to different needs and skills, as these vary greatly in such a young age group.

4 Conclusions

Here we will outline what we learned from the challenges that we encountered during the course of our project, and how we want to address them in the future.

4.1 The challenge of recruitment

One of the main challenges was recruiting children for our study. In this respect, working with schools has a big advantage over trying to recruit children for after school activities, as most children in the class will be able to participate - provided that their parents sign the consent form.

However, schools usually have very little flexibility when organising activities outside the curriculum, so it is necessary to compromise with teachers and with the administration to find time for user studies.

Working with a library combines the best of both worlds: on one hand, we were able to recruit children through an established institution that already had a community of parents and children readers, but since the activity was organised after school we had much more flexibility in when and how we organised our study.

However, it is worth mentioning that the turn out to the sessions was not great, with many children attending only a limited number of sessions and some signing up but never attending. Since we had anticipated this issue, we accepted more children that we had estimated we would need, as we - correctly - assumed that not all of them would attend every session.

We also had to compromise on the age range of the children who enrolled in the activity, as some parents would only bring their child if their younger sibling was allowed to attend - even if they were younger than the cutoff age of 4 years old. In the end, this was a blessing in disguise, as those younger children also attended the second set of sessions, allowing us to follow their development over a period of months.

Overall, we believe that partnering with established institutions with ties to the community, such as libraries, code clubs or summer camps can be a valuable alternative for those researchers who do not have the possibility to conduct research within a school, or who need more flexibility than a school can offer.

4.2 Ensuring diversity

While collaborative design sessions usually involve a small number of children, it is important to avoid selection bias as much as possible, and try to have a wide range of diverse children in terms of gender, nationality and socio-economic factors.

Of course, this is not always possible in every individual study; for this reason, we strongly advocate for the usefulness of replication studies, conducted for example in different countries or with different populations.

Working with schools can help provide a diverse group of children, although that is very dependent on the school. When we worked with a private preschool, for example, most of the parents were well-off professionals, but they also came from several different countries as the university nearby attracts foreign skilled workers. In a public school, we would a find a wider socio-economic range of students, but depending on the school we could have had a majority of local students or a significant refugee and migrant population.

On the other hand, when participants voluntarily apply to take part in a study - as it was the case with our co-design session in the library - it is much harder to have a diverse group of participants, as we have little control on who decides to take part. While, given enough volunteers, it is possible to use screening surveys to select participants, in our experience finding willing participants was already an issue in itself, even without performing any kind of selection.

4.3 Running the sessions

When working with children, it is important to put them at ease and build a relationship with them. Because of this, we believe that it is important to run multi-session studies, with the aim of getting to know children and getting the children to know one another, if they do not already.

For the same reason, each session should begin with a short ice-breaking activity and eventually a snack, to help children get into the right mindset for collaborative design.

According to our personal experience, it is ideal to have at least three researchers present for each session, with one of them taking notes and recording the session. Having multiple researchers present enabled us to give individual attention to each child, allowed even shy or younger children, who were reluctant to participate, to be fully involved with the activity.

In fact, one of the most significant challenges that we encountered was running the sessions in such a way to keep all children engaged and in a state of flow, even if they were not only of different ages - between 4 and 6 years old - but they also had very different personalities, with some very outgoing children who always spoke and some shy children who were reluctant to express themselves.

We believe that each child should be empowered to create and share design ideas during a collaborative design session; this meant that we had to find a balance between giving space to younger, shy children to express themselves and allowing older, extroverted children to participate in the activities without dominating the conversation.

4.4 Mediating Needs

As mentioned in the description of our studies, parents play an important role in enabling and facilitating children's participation. They often had a conservative approach towards technology; while acknowledging its importance for their children's future, they were very cautious about introducing it yet as they are generally afraid of exposing children to the risks of becoming addicted to screen time.

Similarly, teachers were remarking on the importance of non-digital skills and competences to develop before exposing children to the distractions of the digital world. Children instead were captivated by technology, and in particular by screens and toy robots interacting with them via speech, colors and music.

We decided to be very upfront and describe in details the kind of content and technology we would present to children in the various sessions and this

transparency was well received by the involved adults, that in exchange gave us their trust. Needless to say, mediating between the need for control and protection as advocated by parents and that for engaging children with examples of the current technology in order to get their early feedback proved one of the complex challenges in this research. We managed to find a common ground by listening to educators and being respectful towards all stakeholders.

Overall our lesson learned is that inclusivity does not come easily; instead it requires careful planning and effort, but being open and ready to listen is already a good step towards it.

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