# In Pursuit of Inclusive and Diverse Digital Futures: Exploring the Potential of Design Fiction in Education of Children

Sumita Sharma[1], Heidi Hartikainen[1], Leena Ventä-Olkkonen[1], Grace Eden[2], Netta Iivari[1], Essi Kinnunen[1], Jenni Holappa[1], Marianne Kinnula[1], Tonja Molin-Juustila[1], Jussi Okkonen[3], Ole Sejer Iversen[4], Sirkku Kotilainen[3], and Rocío Fatás Arana[5]

[1]INTERACT Research Unit, University of Oulu, Finland. {firstname.lastname@oulu.fi}
[2]Department of Human-Centred Design, Indraprastha Institute of Information Technology, Delhi (IIITD), India
[3]Faculty of Information Technology and Communication Sciences (ITC), Tampere University, Finland
[4]Department of Information Studies, Aarhus University, Denmark.
[5]Department of Interaction Design, Unitedworld Institute of Design, Karnavati University, Gujarat, India.

**Abstract.** 2020 marks the beginning of a new era as the pandemic catapulted us into new digital and virtual ways of everyday life. As the world changes, we reimagine empowering, equitable, accessible, diverse, and inclusive digital futures, through a series of projects and workshops with a diverse set of participants - children in schools and Child Computer Interaction researchers. We conducted one long-term project with two schools in Finland and two one-day workshops with an international set of participants. Through an analysis of participants' experiences and outcomes in the project and workshops, we build a case for diversity and inclusion ***through*** design fiction in the context of children's education. In addition, through an analysis of the process we as researchers took for developing the project and workshops, we showcase the support of diversity and inclusion ***in*** design fiction.

**Keywords**. Design fiction, participatory design, children and technology, design education.

## 1.    Introduction

Speculative and critical design have received increasing interest in the design community. Through the foundational works by Dunne and Raby [21][22], speculative and critical design (SCD) characterize the design and display of thought-provoking designs of the future. Our focus is particularly on design fiction, which, among other speculative and critical design approaches, has received attention during recent years (see e.g. [1][5][20][49][52][58][67][71]). Generally, design fiction can be characterized as allowing us to envision and explore speculative futures and alternative presents and to engage diverse stakeholders to critique, question, provoke, and pose value-laden

questions (e.g., [9][23][45][48][52]). We see it as a tool for 'collective dreaming' of what the future could be, in Sanders and Stappers' [56] words. However, design fiction can be interpreted and used in various ways [52][67]. Moreover, despite the topic being widely discussed, the potential of design fiction in an educational context, such as for children, with children, and by children, is underexplored [1][32][58][67][71].

Design fiction, and related SCD approaches, are considered valuable to teach to future professionals and designers as they offer a useful, alternative set of approaches in the design repertoire, enabling in addition to innovation, probing, questioning, reflecting, and raising awareness on our digital futures and associated values. In addition to the context of higher education [30][73], design fiction has been applied in a multitude of ways with diverse participants, such as with schoolchildren [20][49], with elderly [10], with citizens of a city [55], with vulnerable users of medical technology [53], users of energy technologies [55], and with other non-design experts [72]. Furthermore, Child-Computer Interaction (CCI) research, which underscores the value, and need, for children to not only be technology users, but co-designers and co-researchers [19], and also protagonists in their own technology use and design [35][39][43], has started to explore the potential of design futuring approaches for children's computational empowerment [40] and technology comprehension [64]. Children have been invited to design, discuss, and critically analyse their own digital futures with the goals of empowerment and nurturing them as design protagonists [1][20][49][67].

Further, there is a growing interest in diversity and inclusiveness in education (e.g., [6][29][57][59][74]). This research lies within design education research, where diversity and inclusion are significant concerns in terms of student participation, and as a topic of research itself [57]. Diversity and inclusion are currently significant concerns regarding design and technology as well: for example, in Artificial Intelligence (AI), there are strong calls to ensure inclusive solutions, created by diverse technology development teams that are seen to create a social buffer that mitigates algorithmic bias through different perspectives collaborating [4][14][24][46][69][75]. Thus, the need for inclusion and diversity does not only concern technology development but also its use. The focus here is to ensure inclusion of a diversity of users and contexts of use [4] [24] [69][75]. All this connects with the call for an inclusive approach to how we imagine, design, and use technology to ensure that all stakeholders, inducing children, are able to fully participate and be involved in shaping their futures (see e.g., [34][36][56][68]).

In this work, we explore the potential of design fiction with children in the context of education, approaching it at two levels: first, as employing design fiction with children in schools as integrated into their basic education, particularly connected with their technology education while many other subjects as well (see e.g. [35][40][64] and second, by educating adults who work on technology design for, with, and by children (e.g. CCI researchers who work both with children and with education providers) to employ design fiction in their work on children's empowerment, inclusion, and digital

futures. We particularly examine the potential of design fiction for advocating diversity and inclusion. Thus, we explore the potential of design fiction in the context of children's technology education as a tool for promoting diversity and inclusion **in** and **through** design fiction: we ask, first, "*how can design fiction enable diversity and inclusion in an educational context across a variety of users, uses, and contexts of use* (**in**)"?; and second, "*how can design fiction be used to create a space of diversity and inclusion* (**through**) *in the imagined digital futures*"? To address these research questions, we examine a long-term research project with schoolchildren as well as two workshops with CCI researchers, industry experts, and practitioners, all these cases addressing the topic of design futuring with children.

The paper is structured as follows. Section two presents the theoretical framing for the study, including related research and the theoretical concepts used in the analysis of design fiction. Section three introduces the cases where we have utilized design fiction techniques and approaches. Section four analyzes the ways that diversity and inclusion have been supported in and through design fiction in the cases. Section five summarizes the findings and discusses their implications. Section six concludes the paper with recommendations and insights regarding inclusion and diversity in and through design fiction.

## 2.     Related work and theoretical framing

Design fiction combines prototyping and storytelling to imagine alternative futures. This opens a space for dialogue about both the present and the future through design artefacts, sometimes referred to as diegetic prototypes, where speculations about the future can be represented in various ways, for example, through scenarios or film [8]. These creations and the future technologies represented within them are used to explore sociocultural values, norms, and assumptions through design [23]. Rather than to create marketable products, the designed fictions serve as a vehicle for reflecting upon the imagined consequences of future scenarios and the statements they make about present-day circumstances [3]. There is a lot of variety within design fiction; it has been employed in a variety of ways in a diversity of domains. In this section, we briefly describe design fiction and related SCD approaches in CCI research and present our theoretical lens on diversity and inclusion.

### 2.1 Speculative design and design fiction with and for children and youth

Speculative design and design fiction are increasingly employed in a variety of contexts with diverse participants [31][32]. This includes envisioning alternative and empowering futures with children and youth to address a diverse range of topics. Societal issues have been in the focus of the research, such as Maxwell et al. [49] engaging with primary school children using design fiction as a part of a cross-

curricular project to reimagine possible futures from the perspectives of climate change, exploring the world of a honeybee. Ventä-Olkkonen et al. [67] employed critical design fiction, in conjunction with other participatory and drama-inspired methods, to tackle bullying in schools in collaboration with children [67]. DiPaola et al. [18] invited middle school children to critically reflect on the ethical and socio-technical motivations of technology; their was goal to encourage children as "critical users and ethical designers of technology". Inclusive educational futures have also been explored using design fiction. For instance, Metatla & Cullen [51] explored inclusive educational spaces with children with visual impairments through participatory design approaches, Nygren & Price [54] explored embodied learning spaces together with young children (2-7 years) and their caregivers and professionals, and Dindler et al. [16] co-designed an eBag, a digital school bag to store children's audio-visual content and documents used in school projects. Burke & Kafai [12] devised a magic-wand for children to explore elements of storytelling that support the learning process and Duggan et al. [20] worked with young pupils and teachers from disadvantaged communities to consider alternative and inclusive futures for schooling systems in the 21st century. Studies have also explored technologies and their implications on children, such as the design of emotionally sensitive children's products [27], new and emerging technologies [28], and machine learning for teenagers [1].

Diverse groups of children and youth have been involved in studies employing design fiction, including children as young as 2-7 years of age [12], children with visual impairment and their caregivers [51], and children and teachers from disadvantaged communities [20]. Regarding the youth, design fiction has also been explored with university students, with whom design of sustainable campuses [30], the long-term ethical consequences of innovation and technology [71], design of precision medicine systems together with experts [72] and studying challenges in collaborative design through future autobiographies [15] have been explored. For instance, Hauser et al. [30] had students create design fiction short films of a future campus and upload them to a YouTube channel to "catalyze reactions and blur limits between what is invented and what is real, leading to more reflection on current and future practices surrounding tackled issues" (ibid).

In addition to using design fiction directly with children and the youth, researchers have employed design futuring with adult experts to reimagine the design of technologies concerning children. Buruk et al. [13] discuss the age of transhumanism in 2077 as a space where technology provides enhanced augmented sensory and cognitive capabilities to humans. Through their fictional scenarios, the authors raise crucial questions on the ethical, socio-political, and economic conditions that could arise in this context, considering the problems it creates (ibid). Even if Buruk et al. [13] look towards 2077, the issues they raise regarding the ethics of technology use, design, and access, are critical even in the present. Menendez-Blanco et al. [50] challenge the present narratives regarding students with dyslexia and explore the design of critical

artefacts foregrounding dyslexia as a learning difference instead of a disorder. Furthermore, given the troubling educational experiences stemming from the pandemic and its various lockdowns (see e.g., [2][37]), Khan et al. [42] explore the challenges and opportunities in designing educational futures of children in Pakistan together with various stakeholders such as teachers, policy makers, and NGOs, in turn, decolonizing speculative design by adopting pluralist, Global South approaches.

As is evident, children and youth have taken a variety of roles in these studies, they might have been positioned merely as users of future technologies, but also as participants [54], co-designers [51], and in a few cases, as experts of their lived experiences and protagonists (see e.g., [35][39]) of our digital futures [18][49][67]. However, only a limited number of studies have empowered children to envision, critically explore and take action in shaping our digital futures. Considering prior literature, however, it is difficult to ignore how technology is changing the way we live, function, work, collaborate, and learn; and how people of today will require different skills and practises to function in an empowering and sustainable way in the next couple of decades. It is therefore imperative to consider empowering people of all ages, including children, towards critically thinking about their future technological experiences as well as towards taking action in shaping them. We see design fiction as one potential tool to serve that purpose, and this is the motivation for our work.

## 2.2. Theoretical lens

Our theoretical lens consists of two components: the theoretical concepts of inclusion and diversity. A widely cited definition on inclusion sees it as "the extent that individuals, families, and communities are able to fully participate in society and control their own destinies" [68]. More recently, the concept has become utilized also in the context of design and technology. Technology has been seen both as a source of exclusion and as a tool for inclusion [63]. Studies have considered the inclusion/exclusion dynamics in relation both to technology use and development [36], where technology related access, use, skills and attitudes have been considered [33]. Overall, it is important to acknowledge that inclusion is a complex concept [44][47][61][63][68]. Iivari et al. [36], building on prior research to develop a framework to study inclusion / exclusion dynamics in the context of digital technology, maintain that it is a question of both individuals and social structures. They posit that inclusion/exclusion dynamics can be either intentional or unintentional and something that is done for people or by people themselves. Thus, inclusion and exclusion can be (un)intended by the organizers or the participants, or they can be a voluntary, informed choice made by the individuals themselves. It has also been acknowledged that oftentimes powerful social, economic, political, and technical structures create inclusion and exclusion, intentionally or unintentionally (e.g., [65]). In our analysis, we

acknowledge these different senses of inclusion: of individuals and collectives, as intentional and unintentional, done by people or for them.

It is not enough, however, to consider inclusion or exclusion, we need to consider also **who** are included or excluded, i.e., inclusion/exclusion dynamics are intertwined with diversity of the participants. Diversity, or a lack thereof, in technology is a critical challenge we face today [24][60][69][75]. There is extensive conversation on how to improve diversity in various technological innovation spaces, from STEM education in schools to teams designing and coding AI systems. Diversity is usually understood, and applied, within the context of gender, race, cognition, or socioeconomic conditions. Overall, diversity and inclusion within a technology context are multifaceted, while possible to achieve through a three-pronged approach of (a) diversity in the team that design and build technology, that is, ensuring those who are marginalized in STEM education and careers are included, such as e.g. women, people of color, and LGBTQIA+ communities, (b) inclusiveness in the target users in the sense of the technology being designed to cater for wide range users, and (c) ensuring that data used for creating the technology, such as training data in the case of AI algorithms, is representational of diverse set of users [4][24][69][75].

Many approaches, under the umbrella of diversity, seek to increase participation from underrepresented minorities from gender, racial, cognitive, and/or socioeconomic perspectives; however, approaches towards diversity of age are still limited. Then again, CCI research underscores children as experts of their own lived experiences, inviting them to participate in technology design with various levels of involvement, also respecting diversity among children in different senses such as from gender, cultural and socioeconomic perspectives. Experts are also employing participatory design approaches with neurodiverse children within the fields of accessibility and CCI, again breaking some of the barriers that lead to the (lack of) diversity. Yet, in everyday life, children are seldom invited to drive, lead, or reimagine alternative technological futures, for instance, as protagonists [39]. This goes for their technology education as well; if such is offered, topics such as empowerment, inclusion and diversity remain poorly addressed. In our analysis, we consider how diversity can manifest both in the design work and through the design work employing design fiction.

## 3.    Motivation for our work

Design fiction is used in our research in different contexts with diverse participants, goals, and approaches. Our work showcases the versatility of design fiction as a method. That said, there is no single method for design fiction, rather there are a variety of approaches, techniques, and devices that researchers and practitioners use to spark participants' imagination. Our approach is to empower participants by offering them an opportunity to reflect on their digital futures, asking them *what those futures could be*

and *what kind of role the participants could have in those futures*? We also embed in this work elements of inclusion and diversity to expand the scope of design fiction. Here we present the motivation for our work here, and in the next section our approach and methods.

### 3.1 Case 1: Reimagining approaches to reduce bullying in schools

Bullying is a serious issue concerning us all, especially children and young people. HCI research focuses on creating design solutions through the development of apps and other technologies. However, critical engagement with the topic is scarce [37]. For this study, we conducted a long-term project with two Finnish schools, critically engaging with 7-12-year-old children using design fiction, in Make-a-difference (MAD) project[1]. Typically, Finnish schools integrate neurodiverse students in a classroom providing support to cope with schoolwork and environment. This study came about as a result of long-term interest in and support for empowerment and genuine participation of children in the design process. Prior to this case study, extensive work had been carried out with local schools, exploring participatory design in collaboration with different aged children and their teachers. Finnish cities prioritize the mitigation of bullying, harassment, and violence faced by children and adolescents with various planning procedures and practices at schools. We began our year-long collaboration with representatives of the city of Oulu to examine how critical design could be used to reimagine different solutions to bullying in schools.

### 3.2 Case 2: Future-orientation in CCI

CCI research emphasizes empowering children through co-design and co-creation of technology to foster learning both inside and outside the classroom. However, the focus is primarily on present technology solutions and innovations and designing for the now. In many cases this includes only incremental changes in what is implemented, and it is difficult to say how well the children are really empowered [35]. With the Covid-19 pandemic marking the move from physical to virtual modes, schools were required to manage their classes using office technologies such as Zoom and MS Teams. This digital jump left many behind, bringing with it challenges related to access to technologies and possessing the ability to use them [2][37]. To understand this challenge, we engaged with CCI researchers (in academia and industry) and practitioners through workshops in two conferences: one at Interaction Design and Children (IDC'20) and the other at NordiCHI'20. The result was a critical examination of a *Researchers' Toolbox for the Future*[2] which could equip researchers, designers,

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[1] https://interact.oulu.fi/mad
[2] https://interact.oulu.fi/researcherstoolbox

and practitioners with future-oriented tools and methods to imagine technological futures with children.

In the next section, we discuss the context of our work including its goals, approaches used, participant selection methods, and demographics. In the subsequent section, we consider the outcomes from the two cases, specifically, highlighting the inclusion and diversity dimensions of what participants imagined and created through design fiction.

## 4.    Inclusion and diversity *in* design fiction: Project and workshops methodology and participants

Considering diversity and inclusion in our cases, more explicitly concerning our context of work, goals and approaches, and participant demographics, in this section we describe for each case our methodology: what we did, how we applied design fiction, and who our participants were (also summarized in Table 1). The participants varied from young children in the school project to researchers to students working in/studying CCI in the workshops. Not all participants, in the project and workshops, had a background in design education. Our context and approaches are also diverse with in-person projects at schools to online-only conference workshops, from addressing bullying at schools to devising ways to utilise design fiction with children. Thus, diversity is at the heart of this work. Inclusion of children into the project was dependent on the class teachers who showed an interest in participation at the schools we approached. For the workshop, the conference's reach and participation fee influenced inclusion. Nevertheless, in both cases we aimed at offering inclusive ways to engage with design futuring: for children themselves and for researchers and practitioners offering children possibilities to engage in design futuring.

**Table 1:** Overview of the cases including design fiction analysed in this paper

|  | *Uses* | *Users* | *Context of use* |
|---|---|---|---|
| *Case 1: two schools* | Reducing bullying in schools | Schoolchildren | In-person sessions, longitudinal studies with two schools in Finland |
| *Case 2: two workshops* | Research with children | CCI students, researchers, practitioners | Online one-day workshop with international CCI researchers |

## 4.1 Case 1: Design fiction project with school children

The project started with collaboration with the city of Oulu, in Finland. City representatives invited us to collaborate with local schools to examine the challenges children face around bullying. We decided to include different aged children in the project for participant diversity and diversity of outcomes. We selected a class from school B, with international pupils, since they had particularly high diversity of children with different backgrounds, the other class were native Finnish speaking children. In Finland, inclusion in educational context is implemented in schools by integrating special needs and children with learning difficulties within all classes and schools. Most classes have one or more children with some type of special need or learning difficulty, and in fact *all* children are offered various types of support at school. Participant demographics are described in Table 2.

**Table 2:** Participant demographics at the two schools

| School | N of pupils | Gra de | Age | Gender distribution | Langua ge | N of sessions | Session length |
|--------|-------------|--------|------|---------------------|-----------|---------------|----------------|
| A | 25 | 2 | 7-9 | 12 girls / 13 boys | English | 17-18 | 45 min |
| B | 19 | 6 | 11-12 | 8 girls / 11 boys | Finnish | 10 | 90 min |

We followed a similar three-phased approach in both schools: 1) Sensitizing, 2) Design Fiction, and 3) Reflection (See Table 3.) Each phase included several sessions customized to the class schedule. With 6th graders, the sessions ran for 90 minutes and with 2nd graders sessions were shorter at 45 minutes. Usually, sessions were held 1-2 times a week. With younger pupils, some sessions were held with only half the group to ensure more individual guidance. Throughout the design fiction phase, children worked in the same groups of 3-5. Teachers formed the groups prior to the sessions and selected children who they believed were best able to work with each other.

    The whole process started with a sensitizing phase, where children were asked to analyze and think about the current situation. It introduced two topics for the participants: technology and bullying. The technology phase was introduced through different tasks including a technology friendship booklet while bullying was elaborated by creating imaginary personas and scenarios. Inclusion of different aged children was ensured by designing the tasks suitable for all ages. This was achieved mainly through asking participants to draw and give short textual descriptions, or by excluding or simplifying more complex tasks with younger children if they were too demanding.

Next, we turned the focus towards envisioning alternative futures through design fiction, which included ideation, designing, and prototyping activities, and concluded with a theater of the oppressed inspired exercises. To build the mindset, two sets of design fiction videos[3] we created to orient the children towards the future, inspire and awaken their imagination, and motivate them to consider solutions involving technologies that might not exist yet. The first video introduced the concept of design fiction and the second technology-mediated solutions for bullying. Both videos were kept simple to explain the topic in a child-friendly way. With the 6th grade pupils, we

**Table 3:** Design and making process structure at the schools

| Phase 1: Sensitizing | Phase 2: Design fiction | Phase 3: Reflection |
|---|---|---|
| **Sensitizing with technology**<br>- Start interviews<br>-Technology friendship booklet<br>-Children interviewing an adult about technology use<br><br>**Sensitizing with bullying**<br>- Bullying personas (Bully, bullied, bystander)<br>- Bullying scenarios<br>- Letters for a bully or a victim | **Building the mindset**<br>-Introduction to Design fiction<br>-Miracle method<br><br>**Ideation**<br>-Brainstorming & ideation with toys<br>-Scenarios and personas<br><br>**Critical analysis**<br>-Best- and worst-case scenario pictures<br>-Group discussions on underlying assumptions<br>-Reflections on values<br><br>**Designing and prototyping**<br>-Low-fi prototyping<br>-Integrating interactivity to the prototype<br><br>**Drama- theater of the oppressed**<br>-Drama rehearsals<br>-Preparing scenes<br>-Presenting scenes for the audience and interaction with the audience | **Reflection and evaluation**<br>-Final presentations of the prototypes<br>-Peer evaluation of prototypes<br>-Reflective end-interviews |

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[3] Videos available at https://interact.oulu.fi/mad

then employed the miracle method [25], where participants are asked to imagine that a miracle occurs overnight that eliminates a problem they are facing, and examine what is the first thing they notice the next day. Utilizing the miracle method, the groups started imagining possible futures and worlds without bullying. The miracle method helped children become aware of how bullying might affect their lives now and how it could be different without the threat of bullying. During the group discussions, our aim was to ensure equal participation of all children, both the talkative and more silent ones. Next, we started the ideation process using children's toys, such as teddy bears, Legos, for brainstorming. The task was to ideate a digital solution for creating a bullying-free school and society, and for creating a safer atmosphere for all. The small toys and objects were used as inspirational material. The children began with ideation individually, and then compared and combined ideas between the group members to form one shared solution. This was done through personas, scenarios, and storyboards. After this, children critically analysed the best- and worst-case scenarios of possible futures, where the problem was either solved or failed to solve with the ideated gadgets. Underlying assumptions and values behind each idea were examined and discussed in groups. Then, the groups made prototypes of their idea using various crafts materials. They added interactivity to their prototypes using programmable Lego bricks, conductive threads and LilyPad LEDs, Codebug, or Makey Makey. With smaller children we had several extra sessions for crafting prototypes and adding interactivity.

Finally, after the prototypes were developed and their usage scenarios created, we incorporated the theatre of the oppressed [10][11] inspired drama practises in the design fiction process. In the theatre of the oppressed, the actors and audience engage in re-enactments of everyday scenarios with a critical look at power dynamics and marginalisation, and in some cases discuss alternative equitable solutions. The preparative theatre of the oppressed based drama activities ("knowing your body" and "make it expressive") were involved already in the ideation, critical analysis and design and prototyping sessions [26]. In addition, we applied an "Image theatre" inspired method (see e.g., [7]) and in preparing the scenes the groups formed a "frozen image" of the bullying situation. After the drama rehearsals, the children presented their stories, including their prototypes to and interacted with an audience by the means of Forum Theatre. The audience had an opportunity to ask the actors questions. With the class of older pupils, their grade level peers as well as younger ones were invited to see the dramas and engage as the audience. The project ended with a final evaluation of the project itself with the children, receiving feedback on the process and materials.

## 4.2 Case 2: Design fiction workshops with CCI researchers

We conducted two workshops in 2020 with CCI researchers as part of Interaction Design and Children (IDC'20) and NordiCHI'20 conferences. Participants for both workshops were recruited in a similar way: We submitted a proposal to the conference

calls for workshops, and once selected, created a workshop website to advertise it in relevant forums. Interested candidates were asked to submit a short position paper to indicate their commitment to participate. In the position paper, they were asked to provide a short description of their research interests, driving values and motivations, goals, and their vision for the future of their own research, including how their work with children could benefit from incorporating an orientation to the future. We also asked them to consider how their current and future research plans support empowerment of children and to optionally list methods they employ in their work. Authors could also summarize a research study, project, or paper that they were most proud of that was relevant to the workshop topic. Selected participants were asked to fill in an online consent form prior to the workshop. The conference workshop chairs assisted in participant recruitment through various academic mailing lists. The chairs also provided guidelines for scheduling and required all selected participants to register for the workshop (and in some cases also to the conference). Workshop outcomes included scenarios created in small teams of 4-6 people. Further, all position papers submitted to the workshops were invited to a special issue on *Designing the future of technology with and for children* published in Dec 2020[4]. Before the workshops we obtained informed consent, and collected the scenarios and discussions during the workshop, and post workshop feedback as data. Participant demographics are described in Table 4. Organizers of the **Interaction Design and Children 2020 (IDC'20)** workshop included 4 Finns (3 women, 1 man) and 1 Indian national, all based in Finland. Organizers for **NordiCHI'20** workshop included the same people plus two more (one man, one woman) of European nationalities, with one based in Finland. The workshop participants connected from various parts of the world including India, the US, and Europe.

Both workshops consisted of two parts (see Table 5 for details), where we first asked the participants: *Where are we now with regards to CCI research on design futures and how did we get here*? In the second part, participants were introduced to design fiction and other design futuring approaches, and asked to consider: *What is our vision for the future?* Specifically, where do we want to be as a community and individually in the future in terms of CCI research? *How can different stakeholders be motivated towards those goals?* To understand who is going to do what, we asked: *How do we achieve our vision*? We then mapped shorter-term goals leading to the vision to chart how we might achieve the desired outcome. Finally, to understand whether progress will happen or not, we also asked: *How can we know that something has changed?* We discussed the kind of indicators that could be used to monitor progress. Both parts had moderated team activities where participants discussed these questions in small groups of 4-6 people and 1-2 moderators. Using this two-part approach, we critically reflected on and

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[4] INTERACT Special Issue on Designing the future of technology with and for children
https://interact.oulu.fi/site/files/2020-12/interact-4-2020.pdf

examined previous research on children's participation and engagement in designing technological futures, listing the various tools and methods used to ensure equitable participation of children as co-designers and co-creators, and in some cases, as design protagonists.

**Table 4:** Participant demographics at the workshops (age/background not collected)

| Workshop | Number of participants | Participant Gender | Participant expertise in CCI | Duration |
|---|---|---|---|---|
| IDC'20 | 13 (3 teams) | Women | Varying levels - from Masters level to PhD students, to postdocs, CCI researchers and industry experts and practitioners | 4 hours |
| NordiCHI'20 | 7 (2 teams) | Women | | 5 hours |

**Table 5.** Workshop structure for engaging CCI researchers

| Session 1 | Session 2 |
|---|---|
| Introduction to the workshop goals and agenda, participant introductions, ice-breaking activity<br><br>Team activity: where are we now and how did we get here?<br><br>*The focus is on methods that engage, empower, involve, and allow for co-designing and co-creating together with children.*<br><br>Discussion on activity & Session wrap-up | Introduction to future-oriented methods<br><br>Team activity: designing for the future<br>- *Vision and goals: Where do we want to be?*<br>- *Approach: How are we going to get there?*<br>- *Motivations and Drivers: Who is going to do what?*<br>- *Success metrics: How will we monitor our progress?*<br><br>Discussion on activity & Session wrap-up |

## 5.   Diversity and inclusion *through* design fiction: Outcomes from the project and workshops

Considering diversity and inclusion *through* design fiction, in this section we describe the diverse outcomes, including participant generated scenarios and prototypes, from the project and workshops. Children were inclusive in their scenarios and solutions, including not only those who are bullied but also those who bully and considering ways to convert bullies into friends - leaving no child behind. Their scenarios also included various adult stakeholders present within a school, further showcasing the strong inbuilt emphasis on inclusion. Similarly, the adult workshop participants intentionally considered the inclusion and empowerment of various stakeholders, including children, in their utilisation of design fiction to their research plans and studies.

### 5.1 Case 1: Project with Schoolchildren in Finland

In the project, children from two different schools worked in groups to ideate, design, and prototype technologies that fight bullying. In both schools, children focused on technologies that change the affected people's thoughts, rather than just behaviours. The technologies interact with the bullies and the bullied, trying to make them happy, comfort them, turn them into friends, or stop them from having negative thoughts. Their technologies also interacted with adults and bystanders, for example, adults as a helper crew, police, or teachers to intervene, or bystanders that get a way to easily alert help without having to confront the bully. In their stories and personas, the bullies are boys, often described with scary or strong attributes. The bullied are more often girls, sometimes attributed with weak or nerdy characteristics. Adults present in the stories are more often men. Most technologies had an automated system allowing it to navigate wherever bullying is happening, while some focused more on reducing and preventing bullying in the school context.

The outcomes of the school workshops are presented next in more detail, divided by schools. The children's technology ideas are first summarized in a table regarding their uses, users, and context of use, and described in subsequent text including pictures of their prototypes.

**Uses**: The bullying prevention technologies groups in school A ideated included robots, robot animals, manned vehicles such as airplane cars or roller skates, and a superhero transformer. They drew concept pictures and built prototypes of their ideas using crafting supplies such as cardboard, stickers, ice cream sticks, Styrofoam balls or cones and soft toys, and e-textiles and Legos. Prototypes are illustrated in Figure 1. The children focused on ideating *technologies that turn bullies into friends*. In their ideas, the technology stops bullying through for example mind control and gadgets, special perfumes, or heart bubbles. When bullying stops, technologies turn them into friends

**Table 6:** Bullying prevention technologies ideated in school A (7-9 year olds)

| | *Uses* | *Users* | *Context of use* |
|---|---|---|---|
| *Airplane-Car* | Makes bullies apologize. Turns them to friends with paintballs filled with hearts, or being stamped by super speed crew | Automatic monitoring. Can be alerted by by-standers. Crew interacts with bully. | Anywhere bullying happens |
| *Transformer Supergirl* | Stops bullies, makes them apologize. Transforms to a super truck. Mind control, fidget spinner and fire blades | Alerted by bystanders. Interacts with a bully. | Anywhere bullying happens |
| *Autopilot roller skates* | Makes bullies stop with heart bubbles and perfume. Takes them to principal and turns them nice with powerballs. | Alerted by bystanders. Automation bring teacher wearing skates to interact with a bully | School area |
| *Robot pig* | Captures bullies with net, turns them nice by tapping their shoulder. Bullies pay to be freed | Automatic monitoring but can be alerted by bystanders. Interacts with a bully | Anywhere bullying happens |
| *Bullying preventing robot* | Distracts bullies and turns them to friends by asking why they bull others | Automatic monitoring but can be alerted by bystanders. Interacts with a bully | Anywhere bullying happens |

for example using paintballs filled with hearts, by bouncy balls, or by tapping them on the shoulder. One technology simply asks the bully to explain why they are bullying to distract them and turn them into a friend. Some technologies capture the bully, and require them to pay to be freed, or take them to the principal. Many have superhero-like qualities - they fly, have mind control, super speed, can change form, or sense trouble and come to the rescue when an innocent child is in trouble. In addition, the technologies aim to influence the bullies' personality or thoughts. The groups did not ideate technologies only to stop bullying or exclude bullies but technologies that turn

them to friends. This was achieved by ideating ways to influence bullies' personalities, to turn them to "nice", "good", "friendly" persons you can play with again.

**Users**: Groups in school A ideated technologies that detect bullying automatically or can be alerted by anyone. In their stories, technologies were often called by a bystander. This might illustrate children's thoughts about how hard it is to intervene, which also resulted in functionality that allows bystanders to intervene discreetly without having to confront the bully themselves. In the scenarios, *the technologies mostly interact with the bullies* in order to turn them into friends, but also with adult helpers such as the crew of the airplane-car, or the teacher using anti-bullying skates. The groups prepared short plays to showcase how people interact with the technology. When preparing, they embraced the colourful props that were given to them to build their characters. There was great range in the costumes children came up with. They included hats, scarves, glasses, toys, and costumes built to showcase their anti-bullying technology. Only a few opted to wear their typical clothes for the play. There were some ideas that repeated in characters and costumes. In all groups, the bully was played by a boy, and in many they are wearing a police hat or similar, perhaps to emphasize masculine, strong, or even scary qualities associated with the bully stereotype. The bullied character was more often played by a girl, and in many groups wears prop glasses and a scarf, maybe to emphasize the nerdy, physically weaker bullied stereotype. Furthermore, in two groups the bullied girl holds a toy, signalling they were only playing and doing no harm. Whether these stereotypes were intentionally built into the characters is interesting to ponder upon, but groups might have also adopted fun costume ideas from each other.

**Context**: Many technologies ideated in school A *appeared to fight bullying where they were needed*, as bullying can happen anywhere. Two centered around the school context - they interacted with students but also adults like the principal and teachers.



**Fig. 1:** Airplane car, Transformer Supergirl, Autopilot roller skates, Robot Pig and Bullying preventing robot

**Table 7:** Bullying prevention technologies ideated in school B (11–12-year-olds)

| | *Uses* | *Users* | *Context of use* |
|---|---|---|---|
| *Mutant Hippo-Turtle* | Stamps persons with a heart, preventing them from negative thoughts (and bullying). Encourages bystanders to step in. | Automatic. Eyes see everything, antennas sense negative thoughts. Interacts with students | School area |
| *Softy* | Punishes bullies with electric shocks. Can teleport to where bullying occurs or to nearest adult. | Automatic - Detects and records bullying. Interacts with bullies. | Anywhere bullying happens |
| *Police car* | Can see the past, and bypass traffic. Can go from small to car-size. Cheers up people with music and disco ball | Anyone can alert it with an app. Bring police to the scene to interact with bully and others | School area |
| *Invisible pig* | Plays the saxophone to make people happy and to stop them from hearing mean things. Invisible. | Automatic. Senses sad people with antennas. Interacts with bullied. | School. Gives time for adult intervention |
| *Brave team* | Santa, Supermonkey, Robot crocodile and stuffed dog stop bullies and play with kids. Make bullies clean the school, give prizes to well behaved. Mind control, reading minds, levitating | Anyone can alert them with an app. Interact with students | School area |

**Uses**: The bullying preventing technologies groups in school B ideated included a mutant Hippo-Turtle hybrid, a stuffed animal, an invisible pig, a manned police car and a team of robotic superheroes. They drew concept pictures and built prototypes of their ideas using crafting supplies such as, cardboard, stickers, ice cream sticks, styrofoam balls and cones or soft toys, and e-textiles and programmable Legos. The prototypes

are illustrated in Figure 2. The groups concentrated heavily on ideating *technologies that make people happy*. Their technologies for example cheered up or comforted bullied persons with music or dancing or prevented bullies from having negative thoughts that lead to them bullying others. Technologies also blocked mean words with music and provided children with friends to do fun stuff with. Two technologies mention punishing the bully - One by giving bullies electric shocks, and one by making them clean the school. Groups also thought about incentivizing kids to not bully by giving prizes to those that behave well. Many technologies included some superhero-like qualities such as teleportation, seeing the past, reading minds, changing shape or size, levitating, or working with power thoughts.

**Users**: Most groups in school B ideated technologies that sense bullying automatically, or can be alerted through an app, thus also avoiding bystanders having to step in. On the scene *technologies interact with students, especially bullied or sad persons*, trying to cheer them up. They also interact with the bullies, talking to them. Adults are mentioned in the descriptions too, for example as the police helping in the situation and using the technology, or as helpers that the Invisible pig gives more time to step in. The groups drew and described personas that are connected to or interact with their technologies. The *bullied* personas in their descriptions included both girls and boys. Overall, they are diverse in their likes, dislikes, and hobbies, but in some scenarios the bullied is described with qualities associated with the bullied stereotype such as being weak, small or wearing glasses etc. The bullied persona is mentioned to be scared of or disliking the bully in all groups. The *bully* persona was a boy in all groups. They had varied hobbies, likes and dislikes. Some descriptions indicate they don't like school: "his favourite subject in school is lunch". In some descriptions the bully is mentioned to look scary, have fangs, or disliking "wimps". Bullies are mentioned to have things that scare them too, such as monsters, wolves, spiders, their parents - or being bullied themselves. *Bystanders* were more often girls of different ages with varied hobbies, likes and dislikes. In many groups, also the bystander is mentioned to be scared of or disliking bullying. One group specifically points out their bystander is scared to intervene. Both the *Helpers* and the *Adults* described being connected to the anti-bullying technologies were predominantly male. They were all adults, most 25 or older. They were mentioned liking things such as their families, sleeping, exercise, food, and crafts. Their dislikes or fears included things like snakes, walruses or spiders, but also those that children might associate with more adult characters, like for example taxes, covid, and the doctor. The physical attributes associated with adult and helper personas included mentions having long hair or being bald, wearing glasses, being tall, strong, muscular, and old. The family structures described for personas ranged from mom, dad, kids and pets to single parent and blended families.

**Context**: Most groups in school B developed their solutions to *fight bullying in schools.* One group explains their technology can intervene anywhere bullying is happening.



**Fig. 2:** Mutant Hippo-Turtle, Softy, Police Car, Invisible Pig, and Santa from Brave team

## 5.2 Case 2: Workshops with child-computer interaction researchers

In the workshops, participants worked in teams of 4-6 to take stock of previous research on empowerment of children and devised strategies to implement future-oriented techniques in their work with children. The workshop outcomes are summarized in the table below and described next.

**Table 8:** Outcomes from the CCI researcher workshops at IDC'20 and NordiCHI'20

| | *Uses* | *Users* | *Context of use* |
|---|---|---|---|
| ***IDC*** *Team 1* | -Studying conflicting perspectives <br> -Being child-led, writing papers for children <br> -Enable critical discussions and reflections, collect authentic data | Children, researchers, designers, other experts in industry and/or academia | -Industry-academia partnerships for testing usability and/or user experience of products or applications <br> -Designing games through PD <br> -Other exploratory contexts, which can be researcher-led or child-led |
| *Team 2* | -Opening up children's mind and imagination <br> -Renewing science through robust studies | Children, researchers from diverse fields | -Children consider alternative futures, opening their minds, and empowering them to consider changing things <br> -Closing the loop, showing the impact of their designs, giving back |

| | | | |
|---|---|---|---|
| *Team 3* | -Children as co-researchers - Children defining issues of importance to study -Community building | Children and researchers | -Explore other cultures, consider different perspectives, make research inclusive through online and offline participation -Enable children to be experts of their own lived experiences |
| ***Nordi CHI* Team *1*** | -Method for self-reflection, critical / collective empowerment -Negotiations between different actors -Promoting activists thinking | Children, teachers, other adults, community, society | -Autonomy (e.g. in mobility) of children through self-designed technology -Developing competence, design thinking, self-reflection, self-expressions |
| *Team 2* | -Empowerment of many different stakeholders | Children, teachers, clubs, NGOs, community | -Integrating future orientation with participatory methods to empower many stakeholder |

**Uses**: The CCI teams ideated a variety of uses for implementing design fiction and orienting to the future in their work with children, especially with the goals of empowerment and inclusion. For instance, orienting children to the future could possibly open their minds to consider alternative or different futures than what is currently probable and consider how such futures can be achieved. Further, studies can adopt long-term perspectives in both process and impact. This in turn can empower participating children, especially if the present is challenging or difficult, knowing that things can change in the future. The underlying mantra in the workshops was - by involving children in design futuring, we can both empower them towards their own futures, and as researchers learn more about the children including their world views. This in turn assists in collecting more authentic and better-quality research data with an impact on the results. Further, researchers toyed with provocative ideas such as writing research papers for children, instead of other adult-researchers, and children publishing their own research commentaries and evaluations of projects they participate in.

**Users**: As expected, there were many users in the cases, as is typical in the context of raising a child; from parents and caregivers, to teachers, schools, communities, and society, and the children themselves. Within a research context, which was the premise for these workshops, another set of stakeholders are added to the mix - industry and academia experts working with children, including researchers, designers, and educators. For the different stakeholders, designing for their opportunities for empowerment were also acknowledged, including cultivating activist-like approaches for community and societal causes, and working towards collective empowerment.

**Context**: While all teams mentioned conducting research on children and technology, which is expected from CCI researchers, there were many different perspectives on how and why design futuring can be applied to their research. Most researchers already employ participatory methods and augmenting those methods with design futuring is one obvious approach. Further, there were discussions on balancing power-dynamics between children and adults, especially in the context of child-led research and in collaboration with industry and academia. For instance, as the workshops were held during the pandemic, researchers speculated on how critical design and future orientation could be leveraged to allow families to reimagine the world they would like to live in once the pandemic is over. Further, child-led approaches allow children to define research topics they are interested in to explore issues that affect them, instead of following what the adults impose. These issues can be multifaceted, and several interesting themes emerged from the researchers' own studies and experiences, such as an exploration of cultural identities in a globalized world with 24x7 social media and connectivity. Additionally, many questioned why researcher papers were not written for children, or even by children examining and evaluating projects. Furthermore, why are children absent from conferences and workshops about them and their lives? Could the entire research process be reimagined to be liberating and empowering for children; helping them to think outside of the box and live outside the box (e.g., poverty)?

## 6.    Discussion

This paper examined design fiction in the context of education from the perspectives of diversity and inclusion, to scrutinize how they can be addressed *in* and *through* design fiction. Both perspectives are considered pivotal in education as well as in the design of our digital futures with increasingly intelligent technologies [36][57]. We approach both diversity and inclusion in terms of *users (stakeholders)*, *uses (activities)* and *contexts of use (purposes)*, revealing the potential of design fiction as an approach flexible enough for diversity and inclusion in its use and suitable for advocating diversity and inclusion concerns. We maintain that design fiction allows us - organizers of the sessions as researchers and educators - to cultivate diversity and inclusion in

design fiction use: inviting diverse groups of learners (designers and non-designers alike) to address a variety of learning topics within divergent educational contexts. Moreover, we maintain that design fiction offers a valuable tool for collective dreaming [56] in the context of education, as it allows learners to advocate for diversity and inclusion through their use of design fiction: addressing significant ethical issues related to our digital futures in terms of diverse groups of people/users with a variety of concerns within divergent everyday life (use) contexts.

Our cases enabled scrutinising design fiction in the context of education at two levels: as used in children's basic education, particularly connected with their technology comprehension, and education while addressing a significant societal problem of bullying that connects with many other subjects as well, such as social studies (in line with e.g., [17][35][40][64]. Hence, this study showcases the value and potential of design fiction in computational empowerment of children [17][40], offering children understanding of technology, inviting them to critically reflect on it and its implications as well as nurturing children's agency to take action and try to make the world a better place, through design and technology among other means. As such this study offers a valuable contribution to the CCI literature: in CCI there is an extensive interest in the education and empowerment of children (see e.g., [38][41][66][70]), while this study shows the value of design fiction as a means serving these goals. Design fiction in this context also enables educating children about diversity and inclusion, encouraging them to advocate such important values in their future life. Moreover, we address education of adults working with children: CCI researchers and practitioners. They were invited to consider how design fiction may be used with children, for different purposes. In this context design fiction enables advocacy of diversity and inclusion as well: by the involved adults, who through their work can educate children about those. SCD approaches, including design fiction, have entered the method repertoire of designers and design researchers and they are being increasingly addressed also in design education (see e.g., [31][32]). They are thus valuable for CCI researchers and practitioners as well, while we think education too seldom familiarizes the future CCI designers and design researchers with these tools and with their potential for advocating diversity, inclusion, and computational empowerment - of adults and children alike.

As for **diversity** *in* design fiction, we showcase it through diversity of participants. Our participants have varied from second grade to sixth grade school students; university students to industry professionals; and academic researchers both with and without design backgrounds. Further, schools in Finland have integrated classrooms, and thus, several neurodiverse pupils participated in our project in an inclusive manner. Less work so far has considered the suitability of design fiction with young children, while our studies showcase its feasibility when modified for children as young as seven years old (some examples with older children can be found, see [1][20][49][67]). Our contexts and approaches are also diverse, from in-person studies with schoolchildren in

Finland, to online workshops with adults at academic conferences. Less research so far has addressed design fiction within online contexts [53][62], while our study provides promising results on its potential online use. Further still, our goals, and outcomes, have also been diverse, from alternative approaches to reducing bullying at schools, to approaches to work with children using design fiction. Overall, our studies show the potential of design fiction in the education of a diversity of topics. As for **inclusion** *in* design fiction, we have *intentionally* introduced it; mostly in the sense as something done *for* people rather than *by* people themselves (see [36]). We maintain that through these learning experiences, inclusion of people *by* themselves may also be more likely to happen, in the sense of increasing participants' agency and empowerment to take action in the world, e.g., for making the world a better place or envisioning, criticizing, questioning or probing our digital futures.

As for **diversity** *through* design fiction, we demonstrate design fiction enables participants to address and advocate it in a variety of ways. Children's envisioned solutions against bullying, in both the schools, included a variety of *uses* (from stamping bullies to turn them into friends to imparting different levels of punishments for the bullies such as making them clean the school or giving electric shock); *users* (from robots and sensors to fantastical animals and creatures); and *contexts* (from school playgrounds to anywhere where bullying can occur). Through these diverse solutions and scenarios, children advocated for values important to them, that is, to find means to stop the bullying, have the bully apologize, and turn the bully into a friend. They also highlighted their understanding of the role of adults in the school context with various scenarios requiring adults to intervene. In our studies with adults, diversity was expressed through the variety of participants' professional positions: from students to commercial practitioners, and academic researchers and faculty. Participants also envisioned a variety of uses for employing design fiction in their work with children - from studying conflicting perspectives and renewing interest in STEAM, to various levels of empowerment and activism for children and entire communities. As for **inclusion** *through* design fiction, the children addressed it in a strong sense: they were imagining and envisioning a world without bullying, where those currently excluded by bullies would be included in a happy school for all. The children not only considered the inclusion of those bullied, but also the bullies, and a number of stakeholders surrounding the problem of bullying: some of their ideas supported inclusion in a *collective* sense and in the sense of something done *by* people, not only as done something *for* them, e.g., by technology (cf. [36]). Their ideas concerned collective action taking against bullying and developing friendships and a positive atmosphere for the entire school community. With adults, inclusion was underscored with the different stakeholders included in the scenarios and approaches envisioned by the participants with respect to their own research methodologies and goals. For instance, the planned participants included - in addition to children, teachers, school staff, and parents - NGOs, communities, and society at large. It is noteworthy that with children, the task

was to tackle the problem of bullying and inclusion was in a sense built into the task assignment. With adults, the inclusion of different stakeholders was not not intentionally introduced by the organizers (cf. [36]). Instead, it resulted naturally through the discussions of whose responsibility it is to make things happen.

The implications of our work, in terms of diversity, is that researchers can adapt design fiction for the purposes of empowering participants to reflect on a given topic and share different ideas. Implications around inclusion were provided by participants' commitment to enable inclusion of those currently marginalized in their designs. The last point allows us to move on to our claim that design fiction in our cases has enabled diversity and inclusion through its use and in speculative diverse and inclusive alternative futures. However, one limitation to our work is how participants were recruited - children in one grade class were selected, which was determined by teachers who proactively volunteered to work with us when we reached out to schools through professional networks. Thus, children in the same school in another class in the same grade were not invited to participate. Likewise, one barrier to inclusion experienced in our workshops with adults was the paid participation required by the conferences (IDC and NordiCHI), even though all the workshops were conducted online. For the future, we decided to switch to hosting our own workshops so that a more diverse group of participants can be involved without the financial barriers brought about by a conference fee paywall. We plan to host open workshops without any fee and in multiple time zones to be truly inclusive and consider workshops open to all children such as through after school activities and clubs.

## 7. Conclusions

In this paper, we focused on the potential of design fiction in education of children for diverse and inclusive digital futures. We examined diversity and inclusion *in* and *through* design fiction by scrutinizing a long-term project with children in two schools and two one-day workshops with researchers, practitioners, and students working with children and technology. We underscored education in this context at two levels: to integrate design fiction in education to empower children as future technology designers and towards their own digital futures, and to employ design fiction with children to critically address societal issues that concern them, such as bullying, again in turn, empowering them towards their own lived experience. In this way, children are nurtured as future design protagonists. Further, we educated not only children in how to employ design fiction but also researchers and practitioners working with children on how to incorporate design fiction in their own work with children. We underscored diversity and inclusion *in* design fiction by inviting diverse participants (in terms of age and professional backgrounds and experiences) and employing design fiction as a tool with them in a variety of uses and contexts, with the hope that our participants, both

children and adults, utilize design fiction as a tool in also outside of our projects and workshops. We assert diversity and inclusion through design fiction by the diverse scenarios and solutions proposed by the participants (children and adults) with the inclusion of various stakeholders and communities. Thus, design fiction enabled participants to address diverse people and consider inclusion of others, in addressing complex social and professional issues. Overall, the versatility of design fiction in education is underscored as well as its applicability in a wide range of topics, with diverse participants, in different contexts, using different approaches to achieve divergent goals, also serving a vision of collective dreaming.

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