frontiers | Frontiers in Education

TYPE Original Research
PUBLISHED 23 March 2023
DOI 10.3389/feduc.2023.1112835



OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Digital Learning Innovations, a section of the journal Frontiers in Education

RECEIVED 30 November 2022
ACCEPTED 03 February 2023
PUBLISHED 23 March 2023

CITATION
Hartikainen H, Ventä-Olkkonen L, Iivari N, Sharma S, Lehto E, Molin-Juustila T and Holappa J (2023) *We learned we can do something to reduce bullying*: Children designing anti-bullying mobile apps to empower their peers. *Front. Educ.* 8:1112835. doi: 10.3389/feduc.2023.1112835



# *We learned we can do something to reduce bullying*: Children designing anti-bullying mobile apps to empower their peers

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Mobile applications have thoroughly pervaded the lives of today's children, who live and learn through and with them. However, limited research has been conducted on children designing such apps and not only using those designed by adults. Inviting children to design such apps is the focus of our study. Moreover, in contemporary society, it is emphasized that children should be empowered to take civic action and engage in making the world a better place. In the literature, however, less emphasis has been placed on how children can be invited to do so through the means of digital technology, particularly mobile application design. In this study, 13–15-year-old children are invited to take civic action to address the serious societal problem of bullying through the design of mobile apps. We discussed the design process and analyzed the applications the children designed from the viewpoint of how they aim to tackle bullying. We examined how their app designs aim at empowering other children in the context of bullying, and thus considered what kinds of opportunities emerge for children to learn skills related to the prevention or management of bullying in the apps they have designed. We showed that the children's app designs informed us of the seriousness of bullying in children's lives and that they advocate for the empowerment of other children in different ways. Hence, we have increased our understanding of how smart, interactive technologies designed by children address the learning and empowerment of other children, i.e., application users. We also studied the children's learning from both their and their teachers' perspectives. This study showcases an alternative way educators can integrate digital technologies and apps in school settings to educate children on important societal matters and digital technology.

KEYWORDS

**design activism, mobile applications, bullying, school, children**

## 1. Introduction

Due to the fast-paced digitalization during the past decade, mobile applications have thoroughly pervaded the lives of children; nowadays, children extensively live and learn through and with such apps (e.g., Hartikainen et al., 2015, 2017; Hiniker et al., 2016; Ventä-Olkkonen et al., 2017). This has been acknowledged in the Child–Computer Interaction (CCI) research community, in which plenty of studies have explored the potential of mobile apps in improving children's lives, particularly their learning

(e.g., Fails et al., 2010; Ahn et al., 2013; Rubegni and Landoni, 2014; Abid et al., 2019; Badillo-Urquiola et al., 2019; Lamarra et al., 2019; Kawas et al., 2020; Bhatti et al., 2021; Papadakis, 2021). CCI research has also invited children to take part in the design of such apps, rather than simply using those designed by adults (Fails et al., 2010; Ahn et al., 2013; Rubegni and Landoni, 2014; Badillo-Urquiola et al., 2019). However, limited literature can be found on inviting children to engage as app designers, which is the focus of our work.

Empowerment of children is on the agenda in society and the CCI research community at present (e.g., Iversen et al., 2018; Dindler et al., 2020; Iivari, 2020). Computational empowerment has been advocated, which entails inviting children to take part, if not lead, in the design of digital technology and to critically reflect on digital technology created by others (Iversen et al., 2018; Dindler et al., 2020). The research emphasizes the importance of integrating computational empowerment into children's basic education (Iversen et al., 2018; Dindler et al., 2020). There is also a multidisciplinary literature base arguing for children's empowerment in society as a whole (e.g., Hart, 1992; Chawla and Heft, 2002). Some CCI writings have also considered how digital tools can be used to encourage civic engagement and action in children (Daily and Brennan, 2008; Campos and Garcia, 2018; Lamarra et al., 2019). So far, however, less attention has been paid in the literature to how children's civic engagement can be nurtured through digital technology, particularly with mobile application design, which is the focus of this study.

We aim to harness mobile application design with children (13–15 years old) for civic action, tackling a significant societal problem like bullying within the context of their basic education. Based on our bullying literature review (Iivari et al., 2021), we relied on a widely cited definition of bullying that sees it as aggressive behavior in which those in a more powerful position deliberately and repeatedly take advantage of this to cause harm to a victim, their peer, who is not able to defend themselves (Olweus, 1994). Bullying is a widespread and heinous problem in society, and CCI research has tried to address it, despite the fact that so far research has been limited on this topic (Iivari et al., 2021). In this study, we described the design process and examined the applications children created from the viewpoint of how they aim at tackling bullying. Because we wanted to emphasize the empowerment of those who have been bullied in these mobile apps, we were particularly interested in asking: "How do children's app designs aim at empowering other children in the context of bullying?" Moreover, as the work was carried out in the context of the children's basic education, we were interested in their learning during the project and wanted to know "what have the children learned during the process"? We examined the learning of the children involved from both their and their teachers' perspectives. For children's education, our study showcased an alternative way for educators to integrate digital technologies and apps in school settings: educating children on important societal matters in addition to digital technology and its design.

The work is structured as follows. Section 2 introduces related literature. Section 3 outlines the research design of this study. Section 4 presents the critical design and making process carried out with the children. Section 5 describes empirical results, and Section 6 discusses the implications of these results. Section 7 concludes this research.

# 2. Related research

## 2.1. Children as participants in civic action and mobile application design

CCI research has a long history of engaging children in design. Children and adolescents have been involved in technology design since the 1980's. Children's roles in the design process have varied over the years, from informants and testers to design partners. Children have been invited to take part in the design process to express their needs, provide feedback on the designs, and engage as design partners in the participatory design (PD) process (Hanna et al., 1997; Scaife et al., 1997; Druin, 1999, 2002; Riekhoff and Markopoulos, 2008; Stangl et al., 2014; Eriksson et al., 2018). Druin, and many researchers influenced by the Scandinavian Participatory Design tradition, have highlighted that projects need to be planned in a way that ensures children's participation as partners and influence in the design process (e.g., Druin, 2002; Guha et al., 2013). Researchers have also underlined political parts of Scandinavian PD, arguing for the empowerment of children and requesting more powerful and influential roles for them, introducing the protagonist role for children in the design process, in which they not only drive the design of digital technology but also critically reflect on it and its trajectories (see, e.g., Iversen et al., 2017; Iivari and Kinnula, 2018).

Although most of the CCI literature considers it important to engage children in the design of any digital technology, at least as users or testers, and often as design partners, not many studies have explicitly focused on their participation in the design of mobile applications. Moreover, even less literature can be found on children leading mobile application design, i.e., not only acting as informants, testers, or design partners during specific sessions but also as protagonists (Iversen et al., 2017). Furthermore, although many studies have involved children in the design of an application, they have not necessarily invited children to design for others, i.e., for users other than themselves. Nevertheless, some CCI literature can be found explicitly connecting children's participation and mobile application design (Daily and Brennan, 2008; Fails et al., 2010; Ahn et al., 2013; Rubegni and Landoni, 2014; Campos and Garcia, 2018; Badillo-Urquiola et al., 2019; Lamarra et al., 2019). Some of the studies have been more focused on exploring a topic with children rather than app development, such as one where children designed a social media application in intergenerational teams to explore danger from strangers (Badillo-Urquiola et al., 2019); however, children have also been involved in projects focusing more clearly on mobile application development, such as one in which child designers created a mobile social media application for learning scientific inquiry skills during a 15-month project in which learner-centered PD and design research methods were utilized (Ahn et al., 2013). PD has also been carried out with children with special needs, such as children with cancer, with young users developing mobile applications for improving the mental health of children (Lindberg, 2013). Mobile book reading and editing applications have also been designed by children in intergenerational design teams (Fails et al., 2010), and children have also been involved in the design of a mobile digital storytelling application (Rubegni and Landoni, 2014).

There are also studies combining mobile application design and children's civic action. In a longer-term PD study with high

schoolers, researchers and children collaborated to realize an interactive mobile map-based tool for fostering civic engagement and participation (Campos and Garcia, 2018). In this case, the tool was developed and evaluated with children. Children were included in the design of a location-based mobile game using augmented reality and location-based mobile technologies (Lamarra et al., 2019). Civic engagement has also been explored by Irannejad Bisafar et al. (2016, 2018) who studied the use of social networking apps in youth-led activism in youth empowerment organizations. They identified not only how apps worked, but also the challenges encountered. The study offered insights into the potential of existing apps to support youth activism. Daily and Brennan (2008) addressed the development of empathy and civic engagement in a program in which children were invited to participate in Scratch programming. However, so far, this topic has received less attention, despite the fact it is important for the education of future active citizens.

## 2.2. The theoretical lens on empowerment

We examined whether and in what ways children create empowering designs for others, i.e., designs aiming at the empowerment of children other than themselves. Empowerment is a complex concept that has been addressed by several disciplines. We intentionally included variety in this concept: we acknowledge that empowerment can be considered not only an individual but also a collective construct, in addition to a motivational and a relational construct (see, e.g., Hardy and Leiba-O'Sullivan, 1998; Iivari, 2020). As a motivational construct, empowerment is approached as increased task motivation, which is seen to be influenced by perceived competence, choice, meaningfulness, and impact (Thomas and Velthouse, 1990). As a relational construct, however, empowerment is approached as power over somebody or something (Conger and Kanungo, 1988). Both approaches to empowerment are very individualistic: they focus on individual empowerment —whether their task motivation or their power over someone or something has increased. However, alternative views on empowerment can also be identified (see, e.g., Hardy and Leiba-O'Sullivan, 1998; Iivari, 2020). Part of the existing works, instead of focusing on individuals and their empowerment, consider collective concerns: in this literature, the basic social responsibility of all concerned is highlighted, and empowerment is approached from a collective viewpoint. This literature contends that in order to empower, one should always consider more broadly those who are oppressed or marginalized in the current situation and take action for their empowerment in the sense of liberation from oppression (Jennings et al., 2006).

## 2.3. Applications for preventing and addressing bullying

Previous research on preventing, addressing, and mitigating bullying in children's lives includes a wide range of technologies and apps, designed by adults: from online lessons to various platforms (Rubin-Vaughan et al., 2011; Timmons-Mitchell et al., 2016; Sánchez and Chamucero, 2017; Nicolaidou and Venizelou, 2020) chatbots (Young Oh et al., 2020), virtual storytelling apps (Hall et al., 2006, 2009; Enz et al., 2008; Watson et al., 2010; Vannini et al., 2011), and games (Raminhos et al., 2015; Calvo-Morata et al., 2019; Kolić-Vehovec et al., 2020; Paracha et al., 2020). Online learning applications are a popular mechanism to raise awareness, educate, and impart skills to children on how to manage their everyday experiences. For instance, the StandUp online learning module was designed to motivate social behavior change in victims and perpetrators of bullying (Timmons-Mitchell et al., 2016). With mobile applications, reporting bullying incidents can be almost instantaneous, although there are known challenges with reporting incidents. For instance, in the case of online bullying, reports of incidents are heavily dependent on whether the bullying was perceived as severe enough to be reported by the victim or bystander, and whether the perpetrator was anonymous (Sutherland et al., 2014). A review of mobile applications tackling bullying and being readily available in, e.g., the Google Play store (Ferreira et al., 2020) showed that most apps only partially address the issues, focusing on either identifying cases of bullying at school, presenting coping strategies to victims, or exploring opportunities to find help at school. The authors argue that by benchmarking application features for those tackling bullying, app designers can envision new or improved features to prevent, address, and mitigate bullying. Gamified apps have also been designed by adults to help children identify and address bullying, including, for instance, identifying when bullying occurs and then reporting it (Calvo-Morata et al., 2020), specifically for bystanders (Kolić-Vehovec et al., 2020), and various emotional and social behavioral training to promote positive attitudes and social behaviors (Thomas and DeRosier, 2010; Mancilla-Caceres et al., 2013; Raminhos et al., 2015; Paracha et al., 2020). Apps have also been designed to teach children healthy mobile online behaviors (Hswen et al., 2014). Gamified apps have also tackled the issue of bullying. Calvo-Morata et al. (2019) analyzed 33 serious games designed to tackle bullying from the perspectives of various stakeholders (e.g., including children, teachers, and parents) and discovered a diverse range of approaches like raising awareness and developing social and emotional intelligence. However, as previously stated, the apps mentioned so far were designed for children by adults, with limited inclusion of children beyond the roles of pilot testers or informants. Of the handful of studies where children of various ages have been invited to design applications in PD sessions, they did not lead or drive the design of the apps (Derboven et al., 2015; Ashktorab and Vitak, 2016; Van Mechelen et al., 2019; Paracha et al., 2020). These studies included a diverse range of activities children contributed to, like, creating stories or narratives of when bullying occurs and how to address it using storyboards or written scenarios (Derboven et al., 2015; Van Mechelen et al., 2019; Paracha et al., 2020) or creating low-fi and paper prototypes (Derboven et al., 2015; Ashktorab and Vitak, 2016). Our work adds to this body of research by encouraging children to envision and design empowering mobile apps to tackle the problem of bullying.

# 3. Research design

## 3.1. Materials and methods

This study is part of a research project spanning several years that started in collaboration with the city of Oulu, during which city representatives suggested exploring how critical design and making can be utilized by participating children to address bullying that happens in schools. Bullying prevention is currently one of Oulu's focus areas, with the city developing strategies against bullying and harassment to implement in local schools, together with initiating education on children's security skills. We decided to take the challenge and start to handle this severe topic with schoolchildren and conducted critical design and making projects on anti-bullying with three local schools and six classes of schoolchildren aged between 7 and 15. This age group was a natural choice for the research because the topic was of tackling bullying in schools–we feel it is important to invite children to take part in the development of technologies that have the potential to affect their lives, and we should invite these child designers to envision our digital futures. Additionally, as some methods require participants to be able to read and write and to analyze their own behavior, technology, and different underlying assumptions and values regarding technology, we decided to approach only schools catering to children in basic education. The age group of 13–15 years is already well-developed in terms of their abilities to reflect on these matters; hence, it is suitable for this study.

City representatives identified volunteering schools through their principals. Participating classes were selected using voluntary sampling: once the schools had been selected, we introduced them to our project idea and located volunteering teachers. We ran the design and making project with six different classes, each with slightly changing foci and methods. In practice, during early iterations of the project, we concentrated on openly envisioning and designing technological solutions for preventing bullying in the future, utilizing methods such as design fiction, theater of the oppressed, and critical analysis and reflection. For more information concerning previous iterations of this project, see, e.g., Ventä-Olkkonen et al. (2021, 2022) and Sharma et al. (2022a,b). During later iterations of the project, like the one described in this article, we shifted the focus more specifically to social responsibility, activism, and the development of anti-bullying mobile apps. The focus shifted to mobile apps because, during previous iterations, children themselves had chosen mobile apps as a possible target for further development. We also used slightly different methods–during the initial projects we used, for example, theater of the oppressed, which was later replaced by design activism.

## 3.2. Project sessions and data collection

In this article, we focus on work carried out with children from two different classes from a local international school who participated in the project once a week with their information technology (IT) teacher during 45-min lessons. As mentioned, the teacher volunteered to join the project with these two classes. The project took place during regular school hours.

Prior to the study, information about the research, in addition to research consent and assent forms were distributed to the students and their guardians. All students took part in the sessions as part of their schoolwork, but research data were only included from the students who had parental consent and agreed to participate in the research. There were 38 students between the ages of 13 and 15. The mean age was 13.5 years. Students were not asked to specify their gender.

Sessions were held separately for the participating classes. Both classes included four groups of students, each with four–five members. The IT teacher divided the students into groups beforehand. The project included different activities centered on bullying, mobile application design, and design activism (Fuad-Luke, 2009), as illustrated in Table 1. During the project, students reflected on what bullying is and how it manifests itself in their community and devised solutions to produce a change in that community through artifacts like mobile apps and activism campaigns. There were both individual and group activities.

In addition to the teacher and students, the project engaged seven researchers, three of whom conducted the design, making, and activism sessions, and participated in data collection. The researchers prepared the content for each activity and sent it to the teacher for comment and refining. To better accommodate the school's schedule and the teachers' IT orientation, we agreed on shorter and fewer sessions than we had previously with smaller children during earlier iterations to suit the class timetables. We also incorporated different digital technologies for sessions and data collection (e.g., online surveys instead of interviews, and sensitizing and ideation tasks with online tools instead of pen and paper) and had students incorporate digital fabrication into the process when producing their activism campaigns.

Data collected during the study were varied and included individual starting and ending surveys with students. These surveys are provided in the Supplementary material. Data included materials produced by the students including Padlets, in which they reflected on what bullying is and how it manifests itself in school, groups' app ideas recorded in Padlets, templates, prototypes, and video-recorded presentations. The material also included activism campaigns produced to promote the apps or raise awareness about bullying, feedback given to groups by other students in the class, and tweaks the groups wanted to make in their prototypes denoted by post-i notes. Finally, the data included semi-structured ending interviews with their teacher (Leedy and Ormrod, 2019): we had a set of predefined themes and questions, but the interviews unfolded in a conversational manner. The project phases and design process activities and the data collected are further discussed in the following section.

For the purpose of this article, we carried out a qualitative interpretive analysis of the data (see, e.g., Eskola and Suoranta, 1998). In our analysis, we focused first on the design outcomes (app idea templates, prototypes, and post-it notes to denote changes to the apps). The researchers collaboratively reflected on and scrutinized them from the viewpoint of how they intended to tackle bullying. We considered what kind of opportunities to learn skills relating to the prevention or management of bullying are provided in the designs. Using the theoretical lens of empowerment, we

TABLE 1 Project sessions and data collected.

| Project phase | Project activities | Length | Location | Work | Data |
|---|---|---|---|---|---|
| Sensitizing phase | 1. Sensitizing through technology | 25 min | Online | Individual | Start survey |
| | 2. Sensitizing with bullying | 25 min | School | Individual/Group | Class Padlet on bullying |
| Critical design and making phases | 3. Ideating anti-bullying apps | 45 min | School | Group | App idea *via* Padlet / Flinga |
| | 4. Paper prototyping | 45 min | School | Group | **App idea template**<br>**Paper prototype**<br>Paper prototype presentation videos |
| | 5. Tynker prototyping | 45 min | School | Individual/Group | Tynker prototype videos |
| | 6. Creating activism campaigns | 120 min | FabLab | Group | Campaign ideas, artifacts |
| | 7. Evaluation of designs and final edits to paper prototypes | 25 min | School | Individual + Group | Feedback Padlets<br>**Post-it additions to app ideas** |
| Evaluation and reflective phase | 8. Final reflection | 20 min | School | Individual | **Final surveys from students**<br>**Final interview with the teacher** (following the project with students) |

Bolded words denote data analyzed for this paper.

considered how the designs aim at empowering other children in the context of bullying. The results of this analysis are visible in Section 5.1. After that, we focused on analyzing children's learning during the project from their own, and their teachers' perspective based on student ending surveys and teacher interview. The results of this analysis are visible in Section 5.2. Finally, all authors collaborated in writing the discussion.

# 4. Critical design and making process

## 4.1. Sensitizing phase

The first phase concerned sensitizing children with bullying and digital technology, which we consider very important: both topics are prominent in children's lives but are not consciously thought of or reflected on normally. To sensitize children to their relationship with digital technology (Activity 1 in Table 1), we asked the students to fill out starting surveys using their phones on an online survey tool (webropol.fi), where we encouraged them to reflect on their everyday life when acting as technology users, designers, makers, and activists. The survey included questions related to their backgrounds and assumptions concerning digital technology and digital fabrication.

The starting survey also featured some questions to help children become more aware of bullying (Activity 2). The students were not asked for their personal experiences on the topic; instead, they were asked to reflect on what could be done to make the school atmosphere nice for all, what students could do to stop bullying in school, and how they think technology could help to create a better atmosphere or to prevent bullying. Sensitization to bullying continued by giving the students a QR code to a Padlet (www.padlet.com), an online pinboard. They used their phone to post thoughts concerning issues like how bullying manifests itself in school, why someone bullies or is bullied, how bullying should be addressed, and who should address it.

## 4.2. Critical design and making phase

The students engaged in critical design and making and creating design solutions of various kinds for themselves and others (Iversen et al., 2018; Dindler et al., 2020; Bray et al., 2022; Goyal et al., 2022). They started by envisioning alternative futures (Activity 3) through creative methods, initiating speculation on potential and desirable futures. We got inspired by looking at existing anti-bullying apps like SomeBuddy and StopIt and some application concepts, after which students were reminded that these ideas were not yet perfect. We invited the students to critically reflect on the designs and to discuss what was good or bad about the designs and how they could be improved. Afterward, the students started to independently develop mobile apps that could help in creating a bullying-free school and society, using pen and paper. Then they moved to work in groups, discussing and negotiating all ideas and then creating a Padlet or Flinga (https://flinga.fi/) to document the group idea. To align with the long-term design and impact of digital technologies (e.g., Fuad-Luke, 2009; Markussen, 2013; Iversen and Dindler, 2014; Smith and Iversen, 2018), the students were asked to think without a filter and to believe that anything could be possible in 10, 15, or even 100 years from now. During this phase, we urged groups to remember that everyone's opinions should be heard and visible in the produced group idea.

During design and prototyping (Activities 4 and 5), the students concretized their design ideas into paper prototypes, where they recorded the name of the app, its purpose, user groups, and main functionalities. Each group member selected a functionality to draw for a paper prototype, featuring descriptions of the functionality. The students also got familiar with the Tynker app (www.tynker.com), which is meant to teach the basics of coding in a fun way. They took a photo of a screen of the paper prototype and worked on tablet computers to add simple features to it, such as making a button responsive.

The students also got familiar with the municipality's FabLab space, which is freely available to the public, in addition to the digital fabrication processes found there. They were introduced

to the concept of activism and its different forms, and they were invited to discuss how they could make an impact in the world concerning the issues they care about. The groups proposed a campaign against bullying in school (Activity 6) to promote their apps or to raise awareness about bullying. Students were asked to fill in a planning form in which teams had to develop a message against bullying that they would want other students and teachers at the school to hear, plan the means through which the group would like to raise awareness about bullying, and promote their anti-bullying app and justify why this media was selected. Groups were asked to fill in a planning form including a message against bullying they would want other students and teachers at the school to hear and the form of activism through which the group would like to raise awareness about bullying and promote their anti-bullying app. The groups were also asked justify why this form was selected. In addition, they included the time and place of the activism campaign and designed an artefact for their campaign (Poster, sign, badge, video, song, piece of art etc.). In the end, the groups also prepared these artefacts for their campaign, incorporating digital fabrication in the process. In the end, the groups also prepared artifacts for their campaign that incorporated digital fabrication.

## 4.3. Evaluation and reflection phase

An important step was the evaluation of the design ideas (Activity 7). The groups displayed their app paper prototypes and gave feedback on others' prototypes by posting virtual post-it notes on their class Padlet, critically reflecting on their own and others' designs (Iversen et al., 2018; Dindler et al., 2020). The students reflected on their app development process revisited all paper prototypes, and individually gave anonymous feedback, including what they liked about each idea, what could be improved, and why. The groups looked at the feedback and reflected on whether they got any ideas or tweaks they wanted to make based on the feedback, other people's app ideas, or campaigns produced. They added physical post-it notes to their paper prototypes describing any possible changes.

The final phase was the final reflection (Activity 8), in which the students completed an end-of-course survey in which they reflected on what they had learned about bullying, ideation, prototyping, and activism. They also reflected on how happy they were with their group idea and activism campaign, whether anything changed in the class atmosphere related to bullying during the project, and how they felt their class succeeded in the project goal, which was to look at bullying critically and to develop solutions for how to prevent bullying in schools where they empower the vulnerable: not only those who are bullied but also those who bully and those who stand by.

The final phase of reflection also included an in-depth interview with the teacher, in which they reflected on issues like bullying at school, mechanisms to intervene with bullying at school, what triggers bullying incidents, who bullies, and who is the victim. We also asked the teacher to give feedback and reflect on each phase of the project, including what the students liked and what was challenging from the teacher's point of view. What was empowering for the students and, if so, how the project might have succeeded in empowering the weaker ones? We also asked if the students thought differently about bullying, digital technology, or themselves and each other after the project from the teacher's point of view and if the teacher's views of these themes had evolved during the project. Finally, we also discussed future projects and how digital technology could be utilized to fight against bullying in the context of schools. The teacher was asked to openly share their experiences. They were explained that they were free to skip any questions they did not want to answer for any reason and that they could also return to any question if they thought of anything they would like to add. Teacher interview data were used to triangulate the data collected from children during the previous phase.

# 5. Results

## 5.1. Created mobile apps

The groups were enthusiastic about mapping out app functionalities and creating paper prototypes. They seemed to enjoy the chance to be creative, and many students drew multiple screens for their group prototypes. The groups were excited to show off their ideas to the class and to discuss them with their teacher and the researchers. The group app ideas and how they approached empowerment are summarized in Table 2.

### 5.1.1. How the apps aim to tackle bullying

The students stayed away from digital technologies that control them, provide surveillance, or automatically detect bullying. Instead, they envisioned technology in which they could trigger the action. The apps tackle bullying by providing users triggering the action with different functionalities focusing on peer support, adult support, or self-help. Although the imagined apps often mixed two or more types of these functionalities, they can, however, be seen as having different main foci in the app descriptions.

- Concerning peer support, the groups suggested it would be useful to allow users to chat with each other or post to the platform to share experiences with others who have gone through the same issues, helping each other with advice and support. As shown in Table 2, half of the apps (4/8) had their main focus on seeking and providing peer support.
- Concerning adult support, users were instructed to inform adults like teachers, student counselors, the police, or other trusted adults about bullying situations. Adults were to respond, providing users with advice and counseling. Some apps also featured an emergency button that one could use to alert adults of the exact location of the bullying situation in case of an emergency so that they could take steps to intervene in more serious cases. A little less than half of the apps (3/8) placed the main focus on providing adult support. In addition, apps focusing on peer support often chose to incorporate adult support in their designs, to tackle more serious bullying cases.
- Concerning self-help, users were asked to fill out a survey to evaluate their mood, or their situation, after which they are offered targeted resources, or suggested what might be the best course of action to proceed. In addition, entertainment

TABLE 2 Created anti-bullying apps and their approach to empowerment.

| App | Description | How apps tackle bullying | Empowerment |
|---|---|---|---|
| Crab Team | Users experiencing or witnessing bullying seek adult help by reporting incidents to teachers or student counselors–anonymously if they wish. Photos can be attached to the report. There is a daily message limit in the app to reduce spam. At the end of the project, the group thought they should add more ways to help, but did not specify what kind. | **Adult support** | Individual, Relational |
| Bullying Lux | Users seek peer support through calls or chat. They can add friends in the app just like they would on any other social media platform. The app features a daily meme for entertainment and inspiration. At the end of the project, the group thought they should also add a hotline with adult support for emergencies. | **Peer support**<br>Entertainment<br>Adult support | Individual and collective.<br>Relational and motivational |
| Anti-Bullying | Users seek peer support by chatting with each other or with a chatbot if nobody is online. They can stay anonymous if they wish. There is a daily questionnaire to track how users are feeling. Users can also report bullying to teachers or parents, including details about who was involved and what transpired. At the end of the project, the group thought they should give their app a catchier name. | **Peer support**<br>Self-help<br>Adult support | Individual and collective.<br>Relational and Motivational |
| Grindr | Registered users seek professional support *via* calls, chats, or booking physical meetings. They can report bullying to teachers, police, or trusted adults, including details about who is involved, what transpired, and why. This can be done anonymously. The app collects and analyzes information concerning why and what kind of bullying happens in the school. In the end, the group was conflicted over the name of their app, which started as a joke to amuse peers and perhaps get a reaction from adults. | **Adult support**<br>Tracking bullying incidents | Individual and collective.<br>Relational and motivational |
| Anti-Bullying Service | Registered users seek professional support through chat, where they can discuss why they were bullied. There is an emergency button to report to the principal or police in the case of serious incidents. The app includes tips on how to handle bullying. In the end, the group thought they should also include peer support functionality and ask the user's age when registering to target content. | **Adult support**<br>Self-help<br>Addition: Peer support | Individual and collective.<br>Relational and motivational |
| ChatBox | Users seek peer support through chat. Professional support is also provided by calling or messaging a psychiatrist. Students can select which professional they would like to talk to. In the end, the group thought they should also include a survey to evaluate the situation. | **Peer support**<br>Adult support<br>Self-help | Individual and collective.<br>Relational and motivational |
| SirHelp | Users seek help by filling out a survey to evaluate the situation, specifying if they are the bully or the bullied, if the bullying was physical, online, or verbal, and if they want actionable advice or to talk. They get targeted content based on the evaluation. Users requiring more assistance can call professionals. In the end, the group thought they should also include a chat with professionals | **Self-help**<br>Adult support | Individual.<br>Relational and motivational |
| Bully Counter | Users seek peer support through chat and help others by sharing their experiences and advice. The "Get help" button offers resources like targeted advice based on user age, and hotline numbers. Users requiring more assistance can chat with adults. In the end, the group thought they should add a section for user posts raising awareness, an evaluation survey of some sort, and a "Shame-a-bully" function. | **Peer support**<br>Self-help<br>Adult support | Individual and collective.<br>Relational and motivational |

Bolded words denote the foci of the app functionalities.

content, like daily memes, can be seen as self-help, as it is meant for cheering up the app users. One app (1/8) placed the main focus on self-help.

In the groups of anti-bullying app ideas, humans are active in making a change in the world, and technology is something arousing their agency (Iivari et al., 2021). Most apps seem to be targeted toward the bullied students as their main user. However, they can be used by all students in the school, including the bullies, and the bystanders. Users both seek and provide peer support in the apps in chats and discussion boards, in the form of exchanging experiences and advice. In addition, self-help is advocated for in order to help users to evaluate and assess the seriousness of situations or their own mood/feelings about them. Adults' roles are to respond to reports of bullying or provide adult/professional support in more serious cases. The groups' ideas sometimes emphasized the availability of anonymity, suggesting that it might lower their threshold for seeking help on this sensitive topic.

Figure 1 illustrates example functionalities of the produced paper prototypes, including (in the top row) messaging a selected person about the incident (Crabteam), a daily meme (Bullying Lux), a daily questionnaire to evaluate user feelings/mood (Anti-Bullying), and anonymously reporting the bullying incident (Grindr). On the bottom row, calling for help (Anti-Bullying Service), peer support chat (ChatBox), a survey to evaluate the bullying situation (SirHelp), and a Get Help button offering targeted advice based on user age (Bullycounter) are presented.

During ideation and prototyping, many groups took inspiration from existing anti-bullying apps and concepts shown to them, for example by incorporating self-help in the form of additional resources related to bullying, or adult help through talking with professionals, like in SomeBuddy. They, however, also incorporated functionalities not visible in the examples, like those focusing on peer support or entertainment. Interestingly, in some groups, students also spotted how apps could potentially be misused and incorporated functionalities like a messaging limit to

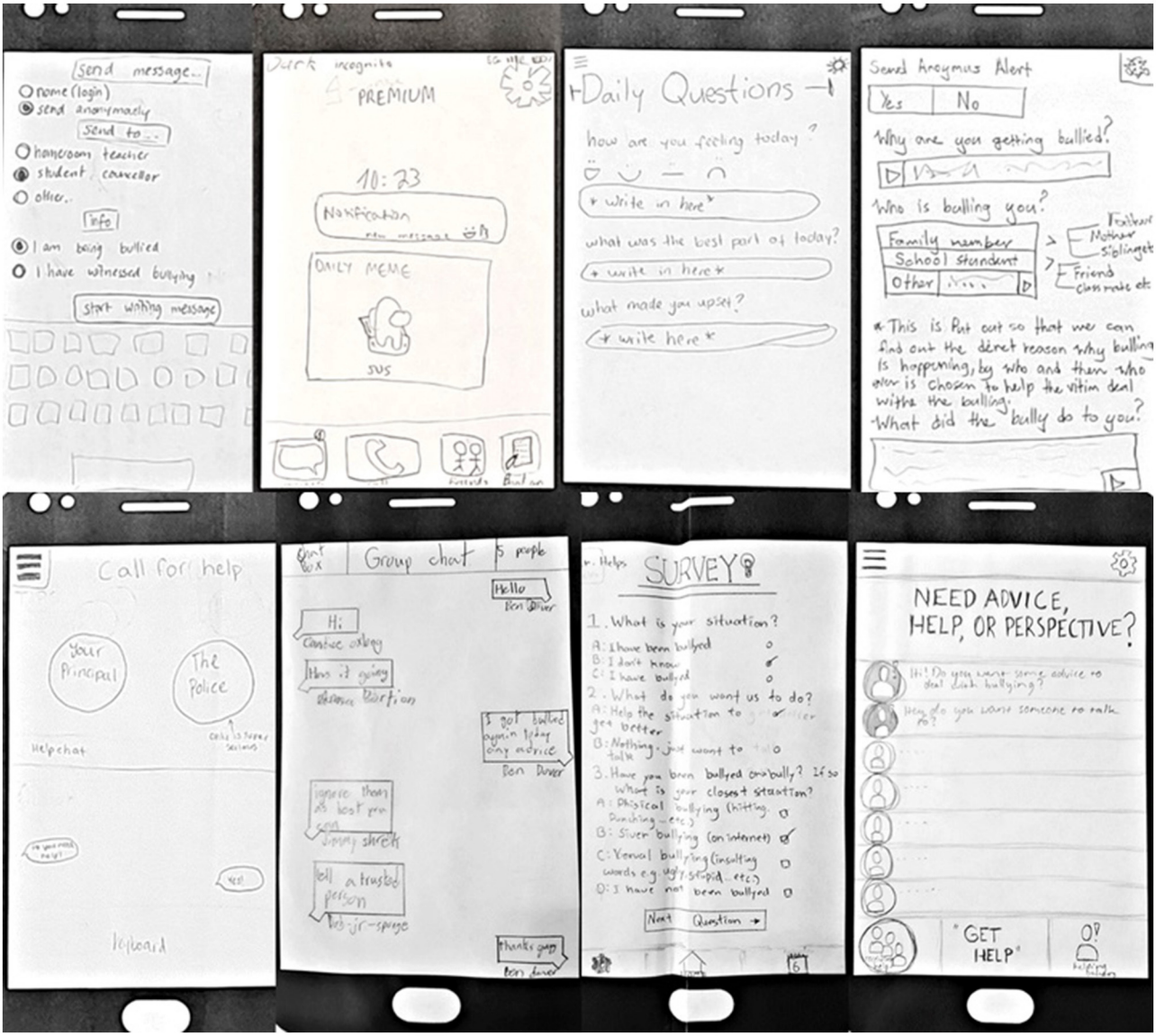


FIGURE 1
Example functionalities from paper prototypes.

restrict the number of spam messages, or requiring users to register to the service to be able to use it.

During the final evaluation and reflection phase, the groups also took inspiration from one another. When making final adjustments to their designs, groups often incorporated ideas from others they saw as potentially valuable, but missing from their prototype: for example, groups that initially had a focus on peer support may have thought they should add adult support too, and vice versa.

### 5.1.2. How the apps approach empowerment

Our analysis of the design outcomes reveals the groups managed to create empowering designs, while their approaches to empowerment differed.

All designs considered individual empowerment–the students were seen as individuals in relation to the problem of bullying, whether they were the bullied, the bully, or bystanders. However, most also addressed collective empowerment (Jennings et al., 2006; Rajanen and Iivari, 2019; Iivari, 2020), visible in the peer support functionalities: the students were to share experiences and advice, helping each other, trying to empower the collective so the school would have a good atmosphere for all. In this way, the entire setting of the bullying problem was considered, not only the individuals involved.

Considering the relational and motivational senses, the designs included mostly elements of motivational empowerment. A clear majority of app designs provided means and tools for individuals to fight against bullying, like communication channels (peer support and chats) with adults or peers, in addition to awareness raising and building a positive atmosphere and anti-bullying attitudes within the community and among youth in general. Relational empowerment of the bullied over the bullies as such was not included in most designs, except for the "Shame-a-bully" function created for Bullycounter.

Instead, the solutions emphasized motivational empowerment by providing channels to seek help from adults. However, from a broader perspective, the goal of the solutions is to decrease the power of the bullies over the victims, and thus solutions could be seen as from the perspective of relational empowerment, too.

In general, collective concerns and social responsibility were highlighted, and designs were not focused on the empowerment of oneself, but on serving those who are oppressed or marginalized due to the status quo and working on their liberation and emancipation as a larger collective (Jennings et al., 2006; Rajanen and Iivari, 2019; Iivari, 2020).

## 5.2. Perceived learning

### 5.2.1. Students' views

The project-ending survey was filled out by 31 students. In their final reflection, 68% ($n = 21$) of the respondents said they learned something about bullying in the project. Those who felt like this learned empathy — considering others' perspectives — (present in 48% of comments, $n = 10$). Empathy was shown not only for the bullied but also for the bully, e.g., *"the bullies also might need some help," "I learned to consider the bullys side too,"* for the side watchers: *"I realized that people might not try to stand up for someone because they have been bullied before or they are too scared to stand up to them, and we should never blame them for anything."* The respondents also learned that bullying has different forms and can affect anyone (present in 38% of comments, $n = 8$): *"[I learned] That anyone can get bullied, or anyone can be a bully and that you have a choice to do something about it."* Furthermore, they realized that bullying can be tackled in many ways and digital technology could be used as a tool for fighting bullying (present in 24% of comments, $n = 5$) and that they can act and take a stand against it: *"During this project, I realized that bullying can be solved in various methods including online apps."* "*We learned we can do something to reduce bullying."*

Furthermore, 87% of the respondents ($N = 27$) reported learning something about mobile application ideation and prototyping. The most prominent theme was the overall design process (in 38% of comments, $n = 10$): "*I learned how to plan out an app and design one through a variation of ideas and sketches."* But they also named specific parts of the design process like ideation (19%, $n = 5$): *"That it takes a lot of hard work to Come up with ideas"* and paper prototyping (19%, $n = 5$), e.g., "*how to organize the design and idea to show them." "It needs more details to bring it to reality."* Finally, the respondents also learned coding (15%, $n = 4$) and operating some digital fabrication processes like vinyl and laser cutting (15%, $n = 4$)*: "I learnt how to code easily and how to use machines I have never used before."* Some learned that they did not want to engage in app development (7%, $n = 2$): *"I learnt how unrewarding and boring I find it."*

In addition to the learning outcomes, the project managed to provide many people with the experience of success and achievement. Overall, 52% ($n = 16$) of respondents were happy about their app idea and prototype. They reflected on their good ideas: "*Our group had unique ideas," "the functionalities were good,"* and the prototype was well-executed: "*prototype turned out to be exactly how we planned*," or they put in the effort: "*we have tried our best," "we worked hard*." The project also helped to improve social and group working skills: *"We learned how to work with different people*." However, there were also reports of contrasting experiences. For example, 10% ($n = 3$) were unhappy about their ideas, citing difficulties in group dynamics: "*Our ideas were not the best as our group members were joking about it," "bad groupwork*" and lack of originality "*It's basic and same as everyone else's*."

Concerning the impact of the project, the majority, or 81% ($n = 25$), however, did not think anything changed in the class atmosphere regarding bullying. Most did not offer explanations as to why they believed so. Those who did, cited contradictory reasons, some explaining the "*class was friendly from the beginning*," others voicing out concern: "*it's still not acceptable*." In contrast, 19% ($n = 6$) of participants felt that their project had an impact. They reported increased understanding and awareness of bullying and the threshold to confront bullying and defend the victims increased during the project: *"Perhaps everyone's perspective on bullying may have changed a bit. E.g., more likely to defend and help victims of bullying."*

### 5.2.2. Teacher's views

The teacher reflected on the students' learning during the design process of the anti-bullying apps from different perspectives. According to the teacher, the critical design process managed to provide versatile educating and empowering experiences to the participating students. The learning outcomes were related to the design process, social skills, and responding to bullying.

Design thinking was taught to the students in the project by following a design cycle, starting from research and ideation and ending with prototyping. The teacher said that learning happened from confusion to gradually increasing the level of understanding: "*I really actually liked the whole idea of this design cycle or design process that you follow, that first introducing something and asking for their own ideas, then explaining research and let them research also about that, and then making a prototype and then feedback and testing and evaluating and those kinds of stuff. So, probably, initially, they might be clueless that, okay, what we are doing, and I wouldn't say clueless, but they were hesitant, they were shy. But then, slowly and gradually, they started to open up."*

Reflection tasks and group discussions in the project enabled students to analyze and identify different types of bullying, and this information was utilized in the students' app designs: "*...some of the groups were so sincere, that they were reflecting really hard, and they were thinking, "Okay, we want this, we want a perspective, we want to do a survey." And the questions that they put in the survey, now I do not remember all of the questions, but then, it seemed to be that they were very thoughtful about it. And even in the template for the application, they had different kind of, not just verbal bullying, not physical bullying, but some other internet safety or something like that, yeah, something like internet bullying as well."*

The teacher also thought that the project managed to enhance students' empathy toward others, especially victims. They pointed out that particularly working in groups boosted empathy building and forced all students to think how it would feel to be bullied: "*...and especially when you're not working individually, you're*

*working in a group, there are a few people who work with you that make you, as a peer, your peer, they make you realize that, okay, now you need to get back and think, come back to reality and think about what if someone has been bullied, or if you are in someone else's shoe, you try to look the world through their eyes and get serious."*

The teacher also maintained that the project taught students how to recognize disrespectful behavior and bullying in the classroom and how to act against it: "*I could see that one of the persons in the group who is more dominating in their own group he wanted to do something, but then those girls who were part of the group, and they were kind of pointing out and saying, "Hey, we are doing this project, and you are behaving like that." So, kind of making him accountable for his own actions. And so, it was a nice thing to see that, yeah, so those girls were taking the initiative and showing it in their own group."*

While the students learned to recognize others' disrespectful behavior, they also started to reflect on their own behavior to realize if they were behaving inappropriately toward others. "*And the girls, in comparison to the boys, I would say the girls are much more sincere and mature. And they are usually, how would I say, accountable, they themselves consider them accountable for their own actions. So, more responsible."*

According to the teacher, the project also enhanced social and group work skills and encouraged shy students to communicate with others, and provided them with feelings of success and confidence. "*So, I just wanted to break that and see how it comes up when you work with different set of people. And I was very happy in the FabLab also, when especially the quietest team in our class, who usually shows their ideas into action, and there were a few groups who were so happy with their result, usually, they work silently..."* "*And then, there was this group also who do not mingle with each other, but in FabLab they did..."* "*they made beautiful frame, and the other people appreciating themselves for the skills that they have..."*

## 6. Discussion

Our study was motivated by the desire to examine how children engage in the design of mobile apps to solve societal challenges. Hence, this study scrutinized apps designed by children instead of apps designed for children and considered how those apps aim at empowering other children in the case of bullying. We also inquired about children's learning when engaging in such a process—both children's and their teacher's perspectives were included.

Our study outlined a process through which the children engaged in the design of mobile apps to solve a societal challenge of bullying. We showed the apps the children designed had a variety of functionalities, with main foci either on peer support, adult support, or self-help; peer support functionality was prominent in approximately half of the applications; and adult support in approximately one-third, while self-help was the main focus in only one project. The analysis revealed that the children addressed other children's empowerment in both an individual and collective sense, with the individual focus being prominent in a couple of apps, while collective concerns being integrated into the majority of app designs. Hence, the designers of these child apps appeared to want to engage children broadly in solving the bullying problem, not only as individuals being bullied or bullying *in situ* but also as ones offering peer support to those suffering. It is important to note how apps designed by adults for children to tackle the issue of bullying do not capitalize on the benefits of peer support. Furthermore, apps designed by adults are more individualistic, focusing on behavior changes and identifying instances of bullying (Ferreira et al., 2020), rather than collective empowerment through peer support and access to a diverse group of adults (e.g., parents, teachers, psychologist, police) through the mobile apps. Connecting with various experts and adults through an app aimed at addressing bullying also reveals how children derived multifaceted approaches to deal with bullying, further showcasing it as a societal problem and not only an individual one or limited to a school context. Moreover, we identified empowering designs in both the relational and motivational sense. The majority of the app designs aimed to offer new means and tools for those bullied to take action against bullying. This did not entail exercising power over the bullies directly but rather asking for adults' help, which was assumed to stop bullying (this way decreasing the power of bullies in general). This type of empowerment of those bullied was evident in the majority of the apps, while others prioritized the motivational empowerment of the parties involved. In most of the apps, motivational empowerment was included through peer support and chat, while some emphasized building a positive atmosphere and anti-bullying attitudes among children in general. Regarding children's learning, both children and teachers agreed that the students learned a lot about the prevention of bullying and the design of digital technology. Social and groupwork skills, self-reflection, a feeling of empathy, and success and achievement were also highlighted. Next, these results are discussed in relation to the state of the art and their implications considered.

The apps children designed revealed many important issues. We learned a lot through analyzing these apps. Through their designs, children communicated the seriousness of the problem and suitable ways of addressing it. These app ideas contribute to the CCI research on digital tools against bullying (see Iivari et al., 2021): there are already some mobile apps developed for children to tackle bullying, but next we should let the children's ideas inform academic literature. Based on the analysis of the apps, we believe that the seriousness of the bullying problem in these children's minds becomes visible through all the "call for help" functionalities meant for emergency situations. These would not have been designed if this problem was not regarded as a very serious one. Then again, we are also pleased to see a collective focus on these app designs in the fight against bullying. Although our process and assignments may have had some influence on this stance, it is clear that children show collective responsibility in tackling the problem. They see the importance of supporting peers, even though the contributions of adults are also seen as invaluable. In addition to the adults' role, we would like to underscore the peer support functionalities and those relating to building a positive atmosphere. Connected with the notion of empowerment (Hardy and Leiba-O'Sullivan, 1998), these functionalities reveal that motivational empowerment (Conger and Kanungo, 1988; Thomas and Velthouse, 1990) was highlighted in these designs, not the relational one (Conger and Kanungo, 1988; Thomas and Velthouse, 1990), which is about offering means and tools that

enable stopping of bullying, even if power for that is usually given for adults of various kind, not only for children. Motivational empowerment is the process of encouraging children to tackle bullying through meaningfulness, choice, self-efficacy, and impact (Thomas and Velthouse, 1990). We believe that meaningfulness was mostly present in these designs, but that other aspects should also be considered in the future. Furthermore, while we see individual empowerment as very significant in terms of giving individuals power and motivation to stop bullying, collective empowerment (Jennings et al., 2006) of children depicted in many app ideas was very positive and gives us much hope in tackling this wicked societal problem. To conclude, we maintain that these child designers managed to create projects that aim at empowering children in many different ways. We should invite these child designers to help envision our digital futures more broadly in the future. It is not only adults who should work as mobile app designers.

We also maintain that we showcased an alternative way for educators to integrate digital technologies and apps in school settings to educate children about important societal matters and digital technology. Our process included (1) Sensitizing with technology; (2) Sensitizing with bullying; (3) Ideating anti-bullying society and apps; (4) Paper prototyping; (5) Tynker prototyping; (6) Creating activism campaigns; (7) Evaluation of designs and final edits to paper prototypes; and (8) Final reflection. We consider the sensitizing phases as significant for the children's learning about bullying and empathy see also (Ventä-Olkkonen et al., 2021, 2022). The phases of ideating, prototyping, and evaluating mobile apps are important for learning about digital technology design, as we discovered through empirical analysis. They are inspired by methods prevalent in the CCI literature on engaging children in the design of digital technology (e.g., Druin, 1999, 2002; Guha et al., 2013; Iversen et al., 2018; Dindler et al., 2020) fitted specifically for mobile application design. In envisioning a positive (anti-bullying) future, we believe it is important to think more broadly about the potential of digital technology to tackle problems in our everyday life. The activism campaign part is specifically geared at encouraging the civic engagement of children, and it is inspired by the existing literature on design activism (Fuad-Luke, 2009), which we also consider a very important part of our design process aimed at tackling serious societal problems. Going through the design process contributed to children's learning about bullying and digital technology, while also developing many 21st-century skills, overall nurturing children's computational empowerment as part of their basic education (Iversen et al., 2018; Dindler et al., 2020). Mobile apps are valuable because they offer children many learning opportunities in their education, and our study shows how their design contributes also to their education in valuable ways. Future research should experiment with the design process and design activism in various ways in various contexts, addressing different topics of societal importance.

## 7. Conclusion

We acknowledge that mobile applications have thoroughly permeated the lives of today's children, who live and learn through and with these apps. However, we identified a lack of research on how to encourage children to act as designers of these apps to address significant societal problems. We engaged children aged 13–15 in civic action to tackle the serious societal problem of bullying through the design of mobile apps. We presented the design process and analyzed the applications children designed in terms of how they aim to combat bullying and empower children. We also examined these child designers' learning and identified many valuable learning outcomes from the data collected from the children and their teachers. We claim to have demonstrated an alternative way for educators to integrate mobile apps in school settings to educate children on important societal matters and digital technology.

Our study has many limitations that should be mentioned. This study has been carried out in a specific country with a specific educational setting and age group, addressing the topic of bullying. Studies in other countries with other age groups should be carried out, also aiming at tackling topics other than bullying. The design process we introduced was also shaped by many practical constraints. All these phases could have been extended in terms of timing and content. However, we believe that the design process served its purpose in our case, while other researchers are warmly welcome to extend and enrich it in different ways. Studies generally engaging children in the design of mobile apps aiming at augmenting their living and learning are recommended, while we particularly call for studies advocating children's computational empowerment (Iversen et al., 2018; Dindler et al., 2020) to encourage children to take civic action to make the world a better place.

## Data availability statement

The datasets presented in this article are not readily available because the material is partly confidential. The raw data that can be completely anonymized and that support the conclusions of this article will be made available by the authors upon request. Requests to access the datasets should be directed to netta.iivari@oulu.fi.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Research data was only collected from those participants that agreed to participate in the research.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Funding

This project was funded by the Academy of Finland (Grant #324685 Make-a-Difference Project). This research is also connected to the Participatory AI with Schoolchildren (PAIZ) project, funded by the Academy of Finland (Grant #340603), and the GenZ project, a strategic profiling project in human sciences at the University of Oulu, funded by the Academy of Finland (Grant #318930). The University of Oulu supports open access to peer-reviewed research articles by covering the publication fees for the article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1112835/full#supplementary-material

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