

CHI Against Bullying

Taking Stock of the Past and Envisioning the Future

Netta Iivari
INTERACT Research Unit, University
of Oulu, Finland
netta.iivari@oulu.fi

Leena Ventä-Olkkonen
INTERACT Research Unit, University
of Oulu, Finland
leena.venta-olkkonen@oulu.fi

Sumita Sharma
INTERACT Research Unit, University
of Oulu, Finland
sumita.sharma@oulu.fi

Tonja Molin-Juustila
INTERACT Research Unit, University
of Oulu, Finland
tonja.molin-juustila@oulu.fi

Essi Kinnunen
INTERACT Research Unit, University
of Oulu, Finland
essi.kinnunen@oulu.fi

ABSTRACT

Bullying is a challenge concerning us all, and particularly our children. This has already been acknowledged by CHI, among others. Despite the interest, there is a lack of comprehensive understanding of the state of the art – a critical review is needed, addressing bullying in the lives of children, in the context of and/or by the means of design and technology, covering CHI as well as related computing fields, being inspired by the strong body of knowledge within human sciences. We report on a comprehensive literature review on the topic, with the aim to understand what and how has been done so far to handle this troublesome and widespread phenomenon as well as to indicate how to move the field forward. We report how the topic has been examined and with what kind of means tackled, revealing interesting underlying assumptions about design, technology and human agency.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI)** → HCI theory, concepts and models;

KEYWORDS

Bullying, Cyberbullying, Online harassment, Children, Adolescent, Youth, Teenager

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1 INTRODUCTION

Bullying is a challenge concerning us all. From toddlers in the kindergarten to adults in the workplace, people gain experiences around bullying as part of their everyday life – as bullies, as those

being bullied, as by-standers, as enablers or supporters. Bullying is a cultural, group-based and power-laden phenomenon, an unwanted yet an unfortunately common one. The society has reacted strong against it, but it seems to be a challenge to subdue it in our society and culture. Even if the problem is prevalent in the lives of adults and children alike, there is a particular concern to address bullying from the perspective of children and their everyday life: we, adults of today, should be taking action to enable the young generation to grow up and live their future life in a world with less concern due to bullying.

The challenge of bullying has already been acknowledged by the CHI community as well as by many other research communities. Research within the disciplines of psychology, educational and health sciences and child and youth studies, among others, have generated a huge body of knowledge on the topic, while also various computing fields have generated their contribution. Some of this vast body of research concerns adults and bullying at the workplace, while most of the literature addresses specifically children and the youth. While surprisingly few studies have so far been published in CHI [5, 38, 75, 89, 91, 95] there are studies published within related publications forums such as in Interaction Design and Children conference [3, 8, 46, 57, 59, 118, 119, 132, 142]. Despite the evident interest, there is a lack of comprehensive understanding of the state of the art in CHI – a critical review is needed, addressing bullying in the lives of children, in the context of and/or by the means of design and technology, covering also related computing fields, being inspired by the strong body of knowledge within human sciences. We have conducted a comprehensive literature review on the topic, with the aim *to understand what and how CHI has so far done against this troublesome and widespread phenomenon* as well as *to indicate how to move the field forward*. We study how the topic has been examined as well as with what kind of means the phenomenon of bullying has been addressed, revealing underlying assumptions about design, technology and human agency. Overall, the review reveals fascinating themes, topics, tools, distinctions and underlying assumptions characterizing current research as well as plenty of untrodden paths for future work.

The paper is structured as follows. Next section discusses the variety involved with the concept of bullying in the literature and outlines how it will be approached in this study. Section three presents the research methodology of this literature review, while section four outlines its main findings. Section five discusses the



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implications for research and design and section six concludes the paper.

2 BULLYING AS A CONCEPT

There are various definitions for bullying. In this literary review, many of the reviewed papers have used Olweus's [108] definitions of bullying either directly or modified those. Olweus [108] defines bullying as a form of aggressive behavior against victims who cannot defend themselves. According to this definition, used by Salmivalli et al. [122] and Johansson et al. [70], among others, bullying is behavior where a child or children deliberately and repeatedly use their more powerful position to cause harm to a peer. Often this happens in the school context which can be specified as school bullying. Casas et al. have used the Olweus's definition as a basis. They see bullying as a psychosocial problem involving intentional and repetitive harming of other people. They also include in their definition the power imbalance between the person being bullied and the bully, which causes negative effects on both sides. [25]

The abuse of power between people or power imbalance is also used in bullying definitions by other authors. Kubiszewski et al. [82] say that bullying is an intentional strategy by students to set up an asymmetrical relationship with another student based on their physical or psychological power. Slee and Mohyla [129] refer to an article by Taki et al. who have argued that bullying behavior is characterized by power imbalance and the intent is to have negative effect on the mental health of the less powerful side of the relationship. In other words, bullying is taking advantage of someone else's disadvantages. Kärnä et al. [83] refer to an article by Smith & Sharp and state that bullying is systematic abuse of power affecting the lives of numerous people around the world, which makes bullying a world-wide problem.

In addition to power imbalance, the negative effects of bullying are highlighted. Bullying is a form of intentional, unwanted and repeated aggression, which is targeted to hurt another person physically and/or mentally [103, 151]. Bullying means systematically and continuously inflicting physical harm and/or psychological distress on one person or a group of people (according to the National Education Association's definition used by Battey and Ebbeck [9]). A highly used definition of a victim, a person who is being bullied, is also made by Olweus [108], used in articles by Kaufman et al. [73], Xu [149] and Saracho [124] which defines a bullied or victimized person as a person who is being repeatedly and over time exposed to negative actions by other people.

Research has also recognized that technology is a medium and site for bullying. Given the extensive use of social media and technology for online communication by schoolchildren, bullying has permeated from school playground to cyber spaces (e.g. [1, 7, 28, 35]). Similar to physical bullying, cyberbullying is multifaceted and includes posting threatening, hateful, or abusive messages via emails, social media posts, and public or private comments and chats, and hacking into accounts to access personal information and/or blackmailing [35]. Cyberbullying can occur also outside the school day, and impacts the school experience and everyday social life of the cyber-victim [1]. A study by Chan et al. [28] with secondary school students and counsellors reveals that bullying moves

seamlessly between the students' online and physical worlds, necessitating action against cyberbullying as much as bullying in the physical world. While the prevalence of bullying vs cyberbullying in schools is under research [28, 109], cyberbullying is potentially just as harmful if not more.

Additionally to these widely cited definitions of bullying, we have been inspired by solution-focused brief therapy [37] in general and its approach to bullying [155] in particular. Solution-focused therapeutic approach has been widely used in social work practice. It has been described as the strength and future oriented approach providing a humanistic stance for problem solving while focusing on the resources of clients and the social environment they live in. Within the approach, a hopeful future is created as well as an empowering relationship between clients and professionals, i.e. social workers specifically. [51] In addition to psychological problems, solution focused approach is considered as an excellent intervention approach for behavioral and interpersonal issues [75]. According to a recent review, there is specifically strong empirical evidence for the strength-oriented techniques and the effectiveness of the method of "co-construction of meaning" used for building solutions with clients [52]. Important to note is that we do not utilize the solution-focused approach literally; instead, we highlight some core issues as foundation principles in the context of bullying. First, instead of problem-based approach, the approach focuses on social behavior opposite of bullying [155: 287]: instead of decreasing or preventing undesired behavior or talking about bullying, it is suggested to focus on favorable behaviors such as promoting friendships and compassion, respecting each other as well as supporting and helping each other. Positive feedback has been emphasized in solution-focused therapy in general [37]. According to Young [155], the aim is that children are happy. Nobody is judged (as a bully or a victim) due to bullying; instead, everyone is considered capable to find solutions for making the school a happy place for all where everyone is helping others to feel good and to enjoy their stay. All children are also considered potential participants in this process, following the idea of a "support group for the suffering child" [155].

3 RESEARCH METHODOLOGY

The literary review was carried out by conducting searches in the ACM Digital Library and Scopus. ACM Digital Library was selected as it includes a number of HCI journals and conferences. However, it also lacks many high-quality HCI journals, due to which SCOPUS was also selected – it includes several respected HCI journals. All the searches were made using different combinations and various modifications of the following keywords: bullying, school bullying, cyberbullying, online bullying, online harassment, school violence, children, youth, adolescent, teenager, student, technology, intervention, program, and prevention. The searches were made with advanced search and the previously mentioned keywords were to be found in the title, abstract or keywords. In SCOPUS, we also limited the results to studies classified as computer science.

The search results were sorted by relevance and the papers were skimmed through. If a paper seemed relevant to the study, it was added into an Excel sheet. The Excel sheet including all the found papers was later analyzed in more detail and if the paper in question did not contain useful information, it was dropped out of this

literature review. The inclusion criteria for papers was that there should be a mention of children or youth or school and technology should be used to either collect data or to help prevent or mitigate the effects of bullying in some way. We considered children to include all minors. We opted for a broad coverage of studies on children and bullying in the computing context: we considered this offers useful insights and inspiration for further CHI research. We excluded papers with no mention of technology or computing. This decision was made because bullying as itself has been studied too extensively to cover it all. We had a specific interest in interventions illustrating how we as a community have taken action against bullying. Hence, we focused especially on studies with an intervention reflecting our disciplinary background and orientation, i.e. utilizing design or technology against bullying. In the end, we excluded papers for the following reasons: the papers did not have any relationship to technology or computing, the papers did not address children, the papers did not include any intervention against bullying or the papers did not report on research (e.g. tutorials). In total, 146 relevant papers were included and added to the Excel sheet (76 from computing disciplines/70 from other disciplines, 53 on primary school-aged children, 35 on adolescents/58 on younger, older or wider age groups, 69 published since 2016/77 published before 2016). The papers are listed in Appendix A, with information on the age groups of children addressed, country of the study, the main methods used for collecting data on bullying and the main focus of solutions proposed for tackling bullying (design or technology). Sometimes a lot of interpretation was needed to identify the main methods for data collection and the main foci in terms of the solutions proposed, as several methods or foci were identifiable, in which case the Appendix identifies the most prominent ones.

Data analysis was done collaboratively and iteratively by the authors. Decision was made first to divide the papers into general categories of interest. The categories that inductively emerged were bullying in general, technology, cyberbullying, methods, and bullying prevention/intervention strategies. Two of the authors carried out the searches and one author the initial categorization, after which the other authors joined in and the authors together brainstormed on how to continue and deepen the analysis. The analysis foci developed in a data driven manner into the following aspects: 1) research methods employed to study bullying and 2) the ways design and technology have been harnessed to address bullying. The authors collaboratively conducted the analysis, which along these lines eventually ended up in focusing on distinct assumptions about human agency, the potential of design and technology; and nature of the interventions introduced around bullying in the literature. These assumptions can be argued of abductively emerging during the analysis process: partly they were still identified in a data driven manner from the paper set, but partly their identification was informed by the broader theoretical framings and backgrounds of the authors. Overall, in the last phase of analysis, we ended up in examining the papers in terms of their assumptions on human beings being 1) lazy, passive, unmotivated to work against bullying, i.e. in need to be monitored, controlled, surveyed, and pushed, or 2) active, motivated to work against bullying, taking responsibility for bullying and being self-motivated for action taking, taking ownership and relying on own initiative. Moreover, we noted whether the interventions emphasized the potential of design or the potential

of technology, whether they focused on problems or on positive aspects and strengths, and whether they were individual or collective focused.

4 FINDINGS

This section first summarizes the methods relied on in prior research to collect data on bullying, and then explores the roles design and technology have played in prior research tackling bullying. Regarding research methods, surveys dominate in our dataset (54 papers), while interviews and reflection-based/creative hands on methods are less common (13 papers, 14 papers). Technology-based methods (28) are discussed in the following subsection, in which studies tackling bullying through technology (66) and design (16) are discussed.

4.1 CHI Against Bullying – A Variety Of Research Methods

4.1.1 Interview/Survey-Based Methods. Questionnaires and surveys are well-used methods for studying bullying within different disciplines (see e.g. [10, 11, 19, 23]). Different kinds of survey instruments are in use, while quite often used is the Olweus' bully/victim questionnaire. As for survey research on bullying, for instance, Chen [31] conducted a self-report surveys of perceived severity and frequency of being bullied with 1816 elementary school students in 13 schools in Taiwan and Ciucci et. al. [32] used "How I feel -questionnaire" with 1379 8-12 years old pupils in Italy. Also interviews and focus groups are used for studying the phenomenon. Kubiszewski and her colleagues [82] studied the relationship between cyber bullying and school bullying by interviewing 1459 11–17-year-old adolescents in France. Agatston and colleagues [1] used focus group method with 148 high school students in United States for understanding the effect of cyber bullying. Interviews and focus groups have been utilized also with younger children for studying bullying at kindergarten in Norway [62].

In the HCI field, surveys and interviews are often conducted in addition to other methods. Usually interviews and surveys have been used for taking stock of the current situation to better target the later - often design oriented - activities. For instance, in a study by Rutta et. al. [119] in Italy, teacher interviews helped to identify typical conflict sensitive situations in classroom on which the children concentrated within the following activities. In [5] survey was used to understand how the (9th and 12th grade) participants in a private high school in U.S. interacted with social media and different technologies, and to provide contextual information to connect design sessions with participants' personal experiences. Also focus groups may serve the same purpose. For example, in [5] focus groups were used for familiarizing with the teenaged participants' environment aiming to understand how the participants interacted with social media platforms and how these platforms might be used for cyberbullying.

4.1.2 Reflection Based Methods. Interviews and surveys ask questions from the respondents, but there are also methods reported in the literature that more intentionally aim at arousing reflection on the topic among the participants. Previous HCI literature describes several storytelling and storyboarding methods for studying bullying and discrimination (see e.g. [16, 132, 138]). For example,

Rutta et al. [118] describe a pilot study with primary school children using a comic-based digital storytelling system. The system facilitated children to create stories and to reflect on situations involving discrimination at school. Tsai et al. [138] used Scratch multimedia editing tool to support storytelling through animation with junior high school students in Taiwan. In this experiment, children were acting in roles of bullies or victims. According to Tsai et al. [138] storytelling is a good approach to situate students in specific scenarios for easily providing assessment and guidance for students to resolve conflicts. Hall [57] used a classroom-based approach with 8–11-year-olds in UK and Germany involving use of electronic storyboarding software for generating and evaluating bullying scenarios. The method aimed to capture the stories and experiences that children tell about bullying. These stories included both physical and social exclusion type of bullying.

Drama based methods, e.g. educational drama [94] or theater of the oppressed [[113], are another interesting category of reflective type bullying related studies. Drama, theater and role-playing methods are quite commonly used and recognized in, for instance, health promotion interventions [71]. Through role-playing children are able to put themselves and others into hypothetical situations and adopt different persons' perspectives and thus, they can define themselves through the role and to see the "other" in themselves. [94]. Joronen states that "Drama can be used to give space to articulate and respond to emotions concerning bullying, to model and practice non-violent responses to aggression, to consider the consequences of one's actions, and to empower children to stand up to bullying." [71]

Drama based approaches have been utilized also in bullying studies in HCI. Paracha et al. [113], included interactive theater-based methods in their participatory design approach for designing and developing a virtual environment with 7-12-year-old children in Japan for moral, social and emotional learning. More specifically they utilized "*Theater of the Oppressed*" interactive theatre where the audience participates in the drama, taking responsibility for actors on the stage, advising them and contributing to the narrative. The authors used the technique to explore story arcs, character motivations and plot points. Another example of drama-based methods in the literature is virtual role-playing in an antibullying intervention "FearNot!" [45]. In this intervention, 8-11-year-old students acted as spectators to bullying episodes but were drawn into the scene through conversation with the victimized character. The intervention strategy aims to increase the awareness of bystanders in bullying and to take more active role by standing up against the bully and helping the victim. The evaluation of the concept was conducted with children in Germany and UK.

4.1.3 Creative Hands on Methods. HCI literature is also strong in employing more design-oriented methods, including various kinds of hands-on, creative type of methods. Indeed, such creative methods have been used, and for several purposes, in previous HCI bullying related literature such as for sensitizing with the theme, developing ideas and low-fi prototyping. For instance, in [142] *drawing* was used as a sensitizing method as 9-10-year-old children were asked to draw a class with bad atmosphere and later to continue by forming a *collage* of problematic situations in a study conducted in two schools in Belgium. *Prototyping* and *making* with

crafting materials was used for ideation and developing further the initial ideas [142]. Also in [5] *bags of stuff* method was used with 9th and 12th graders, accompanied with a scenario description of a cyberbullied teenager, and the participants were asked to create solutions for the bullied teenager's problem. Hall et al. [57], furthermore, used *storyboarding method* for 8-11-year-old children to both generate and evaluate scenarios for exploring bullying issues.

4.2 CHI Against Bullying – Design vs. Technology

4.2.1 Against Bullying with Technology. The literature is full of evidence of educators, researchers, practitioners and caregivers employing a variety of technology-mediated solutions to prevent, address, and mitigate bullying, both online and offline. This can include low-fi approaches such as trainings and counseling using multimedia content and mobile applications, multimodal solutions, to high-fi immersive solutions such as virtual worlds, real time text analysis in online communication and surveillance and monitoring. While technology mediated interventions are common, increased use of technology and social media has ironically also been a harbinger of bullying and online harassment. Approaches to prevent, address, and mitigate cyberbullying incorporate a combination of monitoring, reporting, and educating interventions and solutions [35]. The different technology-mediated approaches towards (cyber)bullying are discussed next.

E-learning and mobile applications: E-learning programs are possibly the most commonly used methods, with successful outcomes, to raise awareness against bullying through trainings and interventions ([117, 123, 137, 105]). A pilot study of StandUp, an online bullying prevention program, with high school students (ages from 14-18 years) in the USA showed that participants improved their social relationships skills already after three sessions with "reduced odds of perpetrating and experiencing emotional and physical bullying, and of passively standing by as others were bullied" [137]. Mobile applications enable quick reporting of incidents [49] and provide a mechanism to teach online safety [95]. Ferreira et al. [49] reviewed ten mobile applications in the context of bullying at schools by comparing them against eight salient features, from identification and denunciation of school violence, to providing coping strategies, information and online links, and news. Their study revealed that of the ten currently available mobile applications (in for instance Google Play Store), none provide wholly or partially all eight features, highlighting needs for improvements. Sutherland et al. [134] worked with 10-12 years old participants in a primary school in Melbourne, Australia, where they asked them to rate the severity and likelihood of them reporting instances of cyberbullying by showing them animated scenarios. They report that "severity played a greater role in influencing bystander's decisions to report than it did for victims themselves" [134], indicating the crucial role of bystanders even in the case of online harassment. Badillo-Urquiola et al. [8] worked with children in the US aged 8-11 years to co-design anti-cyberbullying features for Musical.ly/TikTok that focus on children's agency and privacy and provide automated (adult) assistance.

Multimodal and virtual solutions: While online and mobile-based interventions are frequently employed and studied, there is

a growing interest in exploring novel and interactive technologies for preventing, monitoring, addressing, and trainings both students and teachers against bullying, especially at schools. This includes wearable technology that measures physiological data such as heart-rate monitors, in addition to other forms of monitoring, to detect and identify instances of bullying [18, 48], and multisensory based applications to detect bullying [151, 152]. With the prevalence of virtual reality in the past decade, there is also a keen interest in simulating virtual worlds where participants role-play and enact scenarios or dramas related to bullying [6, 45, 58]. In a study by Stavroulia et al. [133] in Cyprus, teachers aged from 20-45 years were transported into a virtual middle school using head mounted virtual reality glasses where they were presented realistic avatars of students interacting socially. The teachers were tasked to identify alarming behaviors in these interactions and mediate them using gaze-based interaction. While training and education in virtual worlds is a common approach, virtual worlds themselves can be plagued with bullying. Zwaan et al. [Zwaan, 2010] propose virtual buddies that provide peer support for victims of bullying, while Bosse and Stam [15] consider how virtual agents could “minimise the amount of occurrences of cyberbullying in the first place”. They employed a system of rewards and punishments to nudge their participants (aged 6-12 years) towards positive experiences and interactions.

Games and gamification: Games and gamified approaches are making headway as solutions for training participants to identify and handle incidents of bullying [20, 77]. This includes detecting and preventing bullying [21], improving bystander behavior and reactions [77], reducing emotional aggressiveness [92], inculcating attitude changes [114], nurturing empathy [113], bringing out positive social skills [136], and teaching concepts of digital well-being and citizenship [66]. StopBully [114], developed by researchers in Portugal, is a therapy-based serious game that utilizes role-playing, as a victim or bystander, within the context of a scenario or narration to simulate real world situations. Participants, aged 9-14 years, take actions within the games, which have consequences, and which can later be unpacked together with a therapist to create empathetic behavior change. Kriglstein et al. [81] developed and evaluated two games, one with free exploration and one with guided narration, with participants aged 11-15 years in Austria “to raise awareness of the consequences of bullying among adolescents by putting them into the role of a bystander”. Serious games have also been utilized to prevent and address cyberbullying, as Calvo-Morata et al. [20] show in the review of 33 such games. Their list of games reviewed targeted different groups of people – students of all ages, and parents and teachers, and employed various strategies to address bullying and cyberbullying, including raising awareness, creating empathy, and developing social and emotional skills. Addressing cyberbullying requires inculcating critical problem-solving approaches [147], in addition to social and online support systems to report and remove harmful content.

Robots and chatbots: Young et al. [154], employed chatbots with three different profiles, of a bully, a victim, and a teacher, with eighty-nine students in fifth grade (aged 11-12 years) in South Korea to determine conversations with which profile elicit the most change in the attitude towards bullying, and noted changes in the students’ attitudes towards anti-bullying factors. FearNot! [6] is

a virtual storytelling application that translated drama-based conflict resolution to a virtual yet realistic world, where virtual actors (characters) pause and receive advice from the audience. FearNot! has been employed with participants aged 7-12 years in the UK [58, 59], Germany [45, 146], and Portugal [144]. More recently, the use of robots has been explored or imagined for playful interactions that increases also empathy with peers, and could improve emotional regulation, e.g., the EmotoTent design fiction by [3], social engagement [13], and for identifying and mapping physical bullying gestures and behaviors [139]. Bethel et al. [13] studied witness accounts of bullying to human vs robot child-interviewers in the USA with participants aged 8–12 years. Their study found that “children may be less likely to be misinformed by the robot interviewer compared with the human interviewer”, and that they are able to also share more sensitive information with the robot-interviewer. The future potential of this is immense, including, as the authors mention in their work, eliminating subconscious influences on children by human-interviewers in sensitive and delicate situations. However, there are concerns regarding how children understand the role of the robot-interviewer, which is to collect information and that is to be ultimately processed by a human [13].

Surveillance and monitoring technologies: The literature also includes several examples in which technology has been harnessed to monitor and control people for the identification or elimination of bullying (e.g. [18, 48, 53, 60]). Gao & Ye [53] propose an automatic physical and verbal bullying detecting method for schools in China. Han et al. [60] conducted a violence simulation experiment and designed emotion recognition and school violence detection from children’s speech. The simulation was tested in a Finnish elementary school. Ferdinando et al. [48] propose Violence Detection (VITEC) as a possible framework to facilitate multidisciplinary researchers in their fight against violence. It detects violence using physiological signals and activity recognition, and surveillance video. The authors state that “the existing school violence/bullying intervention programs can take advantage of VITEC by providing almost instant notifications of violent events, enabling the victims to get immediate help and intensifying coordination among different sectors to fight against violence” [48]. Brahnham et al. [18] propose a bullying detection/alert system for school-wide intervention in the USA that combines heart rate (HR) monitors, surveillance cameras, multimodal machine learning, cloud computing, and mobile devices. This system alerts school personnel when potential bullying is detected. The system identifies potential bullying by tracking and assessing the *proximity of known bullies* to known students at risk for bullying; by monitoring *stress levels* of students via HR analysis; and by recognizing actions, emotions, and crowd formations associated with bullying [18]. Monitoring based methods have also been applied for studying younger children’s behavior and emotions. Yue et al. [151] developed a system which portrays cognitive learning rules and mental states of young children. They placed small cameras into kindergarten rooms of 2-7 years old children in China, and during each 30-minute class the cameras captured children’s facial expressions every 10 seconds. The system detects children with abnormal behavior such as violent mood and notifies parents and teachers [151].

In the context of cyberbullying, monitoring can be implemented by analyzing online text messages and content to identify words

or phrases that signify abuse, hate-speech, or threats in online social media platforms such as Facebook, Twitter, and YouTube ([29, 35, 41, 68, 78, 88, 125, 128, 135]). This includes labeling content, text, and messages, for instance with community-driven approaches such as user likes (and dislikes) or then automated textual analysis to mark malicious words and phrases. While labeling content is helpful, in many instances, such content can be filtered or sorted to avoid it altogether [35]. Further, to improve monitoring of content, text analysis can be coupled with an analysis of social network structures [41, 68]. In this vein, Huang et al. [68] investigated whether analyzing social network features can improve the accuracy of cyber bullying detection using Twitter data. By analyzing the social network structure such as number of friends, network embeddedness, and relationship centrality detection of cyber bullying could be significantly improved [68]. Technology to detect verbal bullying online through emotion recognition in speech and text has had varying levels of success (e.g. [35, 68, 88]). Labeling or filtering content has not always been the goal. For example, Lieberman et al. [89] explored the potential of reflective interfaces where participants, aged 18 to 22 years in the USA, engaged in nuanced discussions around crowdsourced stories of bullying, similar to their experiences. Macbeth et al. [91] further propose an intelligent system that can be searched for stories or narration on stereotypical cyberbullying incidents matching actual experiences, to provide guidance and support to victims of bullying.

Challenges towards cyberbullying: Particularly related to cyberbullying, it has also been acknowledged that there still are several challenges towards identifying and addressing it [7]: this includes non-reporting of incidents for fear of victim-blaming, for being socially active and subsequently for fear of losing internet privileges, and for publicizing further a possible already public humiliation. There are also difficulties with identifying the intent or motivation of the bully and what is and is not cyberbullying (vs. online pranks) [7, 35, 36]. Further still, even if the incidents are reported, school educators, counsellors, or parents might be unable to competently handle the situation, indicating a need for systematic trainings and interventions and resources [1, 39, 72]. Cyberbullying has been associated with mental health concerns, such as depression and social anxiety [14, 74] and loneliness [120]. The complex and perpetual nature of cyberbullying where the bullied is likely to become a bully, requires further attention. Lozano-Blasco, Cortés-Pascual, & Latorre-Martínez [90] reveal that the most important factor for being a cyberbully was having previously been a cyber-victim, through analysis of studies with children between 11-18 years across the world. This duality of cyber victim-bully is further associated with low social competence, higher rates of depression and social anxiety, and low mental wellbeing. Children from unstable family environments or with troublesome parenting styles were prone to being victimized in the first place [90]. Reducing, preventing, and intervening in cyberbullying can thus recursively reduce also future bullies and bullying.

As evident, many studies deploy technology mediated solutions, however, long-term adoption of such solutions is presently understudied. Further, cyberbullying has its own unique issues including the sheer scale and reach of social media, the little time it takes to spread harmful content, the potential for anonymity of the bully, and possibilities to duplicate and replicate content [35].

While anonymity afforded in online communication is considered integral to cyberbullying, studies have shown that “much of the cyber bullying occurs within the context of [victim’s] social groups and relationships” [72, 100]. Bystander effects are also visible in cyberbullying, where defending behaviors are more likely in the absence of other bystanders [28, 131]. Agatston et al.’s [1] study with 12-17 years old participants in the USA showed that students were unaware of “how to respond as a helpful bystander when witnessing cruel online behavior”, indicating the need for interventions and information for handling and addressing cyberbullying in situ by bystanders. Cyberbullying, thus, is just as important to address in schools as is bullying overall [1, 72, 108]. Educating both children and adults (educators, admins, parents) on what is, and is not, (cyber)bullying and on the healthy approaches to addressing and handling it as well as the victims are needed, with technology mediated interventions for monitoring, mitigating, and preventing (cyber)bullying .

4.2.2 Against Bullying with Design. The HCI field does not only see technology as a solution for addressing bullying, but also design. One could even say that the mainstream of studies around bullying and children in HCI include some sort of participatory design effort to find solutions to prevent and mitigate bullying (see e.g. [5, 8, 38, 46, 57, 132, 143]), even if in our overall dataset this type of studies did not dominate. The goal of these studies is to strengthen social cohesion and atmosphere of a specific class or school [119, 142] or prevent cyber bullying in general [5, 142]. Participating children are primary school aged, typically around 10 years old. More specifically in [38] and in [143] participants were 9-10 years old; in [119] participants were 8-11, in [132] 6-11 and in [95] and in [113] 7-12 years of age. In some cases, the design partners were teenagers, e.g., in [5] and in [16] participants were 14-17 years old.

The studies include various kinds of design activities with children. Typical is that these design activities include a type of storytelling (e.g. [16, 38, 113, 119, 132]), drawn or written scenarios [38, 142, 143] or making different type of storyboards [16, 113, 119]. Many studies also involve different type of prototyping activities such as in [5, 38, 142, 143] and paper prototyping [95]. Also discussions [16, 113, 119] and prototype testing and/or evaluation [5, 113, 119] are mentioned in several studies. Scenarios and stories are used in design activities in different ways for different purposes. Children may create them as design tasks, drawing from their personal experiences and imagination (e.g. [119, 142]) or they might work as inspiration material by researchers or other professionals as scenario centers in [5] and scenarios made by a psychological team in [119].

The design studies in the literature tend to have heavily a problem-focused approach to bullying. For example, in [38] the design sessions with children start with analyzing the problematic class situations. Also in [119] children were asked to represent and reflect individually, or collaboratively, on situations involving conflict in the classroom context. In addition, in [5] participants conducted a pre-survey dealing with e.g. former bullying experiences. This data was used for tailoring further design sessions. A refreshing exception to problem-focused approaches is [132] which presents more solution-focused method for bullying prevention. In this study, storytelling shapes -toolkit enables children to express

Table 1: Underlying assumptions in the literature

Analytic focus	Underlying assumptions	In CHI research
How to study bullying?		
Questions asking	Humans passive providers of information, objects of observation	Often used in combination with other methods
Reflection arousing	Humans active agents making sense of the world	A strength of CHI research
Hands-on engagement	Humans active agents making a change in the world	Particular strength of CHI research
How to approach bullying?		
Through technology	Humans passive objects of observation	Technology for control, surveillance, monitoring, detection of bullying
	Humans active agents making a change in the world	Technology arousing human empathy and agency
Through design	Humans active agents making a change in the world	Particular strength of CHI research
Through a problem-focused approach	Understanding and addressing the problem is needed before solving it	Heavy emphasis in CHI research
Through a solution-focused approach	Instead of problems, the focus should be on strengths and positive futures	Few mentions in CHI research
Through an individualistic approach	Bullying an individual problem, individual responsibility, requiring individual action taking	CHI research focuses on human-technology interaction and use(r) experience
Through a collective approach	Bullying a social problem, collective responsibility, requiring collective action taking from an entire social system	CHI research focuses more at the micro level collaboration in groups, less at the macro level

their needs and wishes by creating a tangible story about things they like to do with others.

5 DISCUSSION

This section summarizes the main findings and discusses their research and design implications.

5.1 Varying Assumptions About Design, Technology, and Human Agency

Based on the literature review, interesting assumptions characterizing existing research can be identified. Those revolve around human nature, the nature of bullying intervention, and the potential of design and technology within. Table 1. summarizes the findings of this study.

Table 1 illustrates that there is a variety of research methods employed to address bullying in CHI. One can identify quite traditional research methods, such as interviews and observations, which seem very common within other disciplines addressing bullying (see the Appendix), but are usually used in combination with other methods in CHI: they are often used during a pre-study phase before using reflection or creative, hands on type of methods (see e.g. [5, 119]). Such methods place the participants into relatively passive positions as providers of information and objects of observation. We think CHI research can truly contribute to bullying research with its method repertoire, those methods aiming at arousing participant reflection, including for instance storytelling and drama-based

methods (see e.g. [57, 113, 119, 132, 138]) or even empowering participants to start designing and making proposals for change (see e.g. [5, 113, 142]). These methods clearly hold alternative assumptions about the human being, who are seen as capable for reflection and sense making as well as for action taking for the better world. We, however, identified a lack of therapeutic methods in CHI as well as in research on bullying more generally. To address this gap, we later propose guidelines on such methods so that their fundamental principles could be used to inspire and guide CHI research.

Table 1 also illustrates that several distinctions can be identified from CHI research concerning the nature of the means with which one is expected to tackle bullying. A common feature in computing research is to suggest technology-mediated solutions. Our review identified a huge number of those. However, we also identified a lot of variety within. The literature includes several examples in which technology has been harnessed to monitor and control people for the identification or prevention of bullying (e.g. [18, 29, 35, 48, 53, 60, 68, 125, 151]): in these cases, technology aims to identify instances of bullying and sends out notifications or alerts. In such cases, nurturing of human agency is clearly not in focus. More room for human agency is offered in various kinds of solutions for identification and reporting of bullying incidents done by humans. Moreover, plenty of educational solutions have been introduced for awareness raising and behavior change (e.g. [95, 117, 123, 137]), including different kinds of games and gamified solutions (e.g. [21, 77]). Technology may also facilitate participant role-play and drama acting (e.g. [6, 45, 133, 154]), for exploring and experiencing bullying related situations. Empathy building [3, 113,

114] and bringing out positive social skills [136] in participants may be the goals of such solutions, which may even include engagement with a therapist to create empathetic behavior change [114]. Hence, we see a trajectory forming from strong technology control to priority for human empathy and agency.

Not only technology is seen as a solution, but also design: the literature includes several studies reporting on participatory or co-design activities of children, addressing bullying (e.g. [5, 38, 46, 57, 132, 142]), these studies clearly allowing room for human agency as regards bullying. Even if these studies from a minority in our overall dataset, they are common in the HCI field. These studies have included design and making of solutions of various kind to tackle bullying as well as more general aims relating to strengthening social cohesion and atmosphere of a specific class or school [119, 142]. In many of the studies the work has entailed exploring current problems [38, 95, 119, 142, 143], while interestingly in some studies the focus has rather been on positive futures than problematic currents [132]. In some of the studies also drama-based methods have been experimented with [113] or a psychological team has been engaged [119].

As is evident, in many technology and design based approaches there has been an emphasis on the problems; on their detection, surveillance, reporting. However, we have also identified, inspired by the solution-focused therapy [37, 155], studies that do not delve in the problem of bullying but rather try to rely on and nurture the existing strengths and positive aspects: some evidence for such could be identified from technologies aiming at bringing out positive social skills [136] as well as from design sessions in which children tell what they like to do with others [132].

Moreover, the solution-focused therapy approach [37, 155] enabled us to distinguish between individual and collective focused approaches. The monitoring, surveillance and detection focused solutions do not try to engage a community around the topic. Many reporting, educational and game-based solutions also seem targeted for an individual. It seems this literature assumes bullying is an individual problem and elimination of it is individual responsibility, requiring individual action taking. On the other hand, interaction among the participants is also facilitated in many technology based solutions: for example in case of robots, chatbots or virtual worlds, social aspects are underscored [3, 6, 45, 113, 114, 133, 154]. The same goes for participatory or co-design sessions, in which children are invited to collaboratively address common issues in their class or school [5, 38, 46, 57, 132, 143]. Even if it is not entirely clear how broadly the studies strive for collective responsibility and action taking, they clearly employ a view of bullying as a social problem and collective responsibility that requires collective action taking from an entire social system. The studies variably bring up stakeholder groups and roles associated with bullying of children. In addition to children themselves, teachers, schools and parents are often mentioned. However, we did not find a lot of research explicitly engaging all key actors within the social system to take part in finding solutions for making the school a happy place for all; where everyone is helping others to feel good and to enjoy their stay (cf. [155]).

We argue the basic assumptions underlying research on bullying can be nicely mapped with constructs adopted from management research, combined with current understanding from

solution-focused therapy (Figure 1): The basic assumptions about the human being in Theory X and Y, introduced in management research by McGregor (e.g. [24, 79]) enable capturing interesting distinctions in the literature on bullying, combined with the individualistic vs. collective focus and problem vs. solution focus as introduced in the solution-focused therapy literature (see e.g. [37, 155]). Part of the literature we reviewed on bullying seems clearly to rely on Theory X assumptions about the human being: it holds a pessimistic assumptions that people are lazy and unmotivated to work against bullying as such and therefore they need to be monitored, controlled, surveyed, and pushed to achieve a desired outcome. People are assumed to avoid taking responsibility of bullying. In case they do, this is approached as individual responsibility and action taking. The focus is heavily on problem identification. The literature holding theory Y assumptions, then again, relies on more optimistic assumptions about the human being: collaborative and participatory approach is to be utilized in bullying interventions, people are seen as taking responsibility for bullying and being self-motivated for action taking, taking ownership and relying on their own initiative. In addition, action taking is broadly considered as a collective process, involving a whole social system, while it is seen that the focus on the entire endeavor should rather be on envisioning and creating positive futures together than on delving on the problems of today.

However, we wish to point out that the distinctions identified do not necessarily imply an either-or choice, but different kinds of approaches can be combined: solution and problem focused, individual and collective focused, design and technology focused. Then again, we also wish to underscore to the CHI community that the underlying assumptions about the human beings tend to be unconsciously embedded into our practices and tools we develop, representing our deep worldviews and values, which are in some cases contradictory and which cannot all be combined. Overall, we maintain that reflecting on these underlying assumptions and values is valuable for the CHI community, also in relation to other topics than bullying.

5.2 Solution-Focused Therapy Meets CHI & Bullying

As mentioned, our work has been inspired by solution-focused therapy approach to bullying. It has enabled us to reveal interesting themes and distinctions in prior research, while we think it should also be used to inspire our future technology and design projects. We acknowledge that some studies have already brought up therapeutic games and collaboration with therapists or psychologists in relation to bullying interventions [114, 119], but so far, they are few in CHI. Then again, we do acknowledge that therapy-based games for children are common in the context of special needs, disabilities (physical, neurological, acquired injuries etc.), and rehabilitation, so the concept is not new to CHI in that sense. However, it seems that therapy-based games towards prevention of bullying are missing in CHI. The benefit of employing therapy-based approaches (e.g. [155]), which are structured on understanding human nature and behaviors (see for example [54] in the context of special needs) to address bullying can be several, including considering both the bully and victim as equal actors who require positive transformations

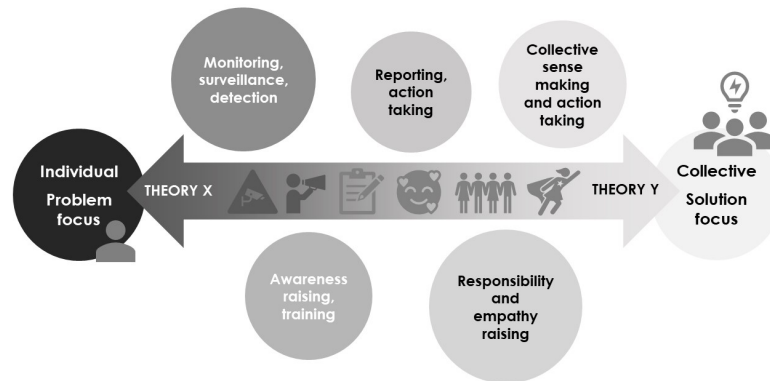


Figure 1: Continuum of CHI bullying research spanning from theory X of individual and problem focused methods to theory Y of collective and solution focused methods.

in their mindsets, attitudes, and mental health, cutting short the recursive and destructive cycle of (feeling of) victimization and the bullied from becoming the bully, and providing social support and tools to deal with everyday life challenges and experiences. [116]

Borrowing from therapy-based solutions and interventions, participatory and co-design approaches can benefit by approaching the challenges of bullying together with different stakeholders – the bully, the bullied, the bystanders, and recognizing adult/social roles and responsibilities of parents, teachers, therapists and counsellors. If the goal is for a happier and more positive school experiences for all involved, then all should be involved in devising ways to mitigate and address bullying. By integrating a therapy-based approach into participatory design, we wish to emphasize the integration between research methods of inquiry and design. We not only highlight the importance of education-oriented reflection, awareness raising, sense making and changing of behavior of individuals, but we enlarge our focus into more discursive and dialogical interventionist approaches typical for therapeutic approaches, relying heavily on dialogical questions and transformation of the attitudes and mindsets. The desire for positive change in the future is there, together with a collaborative approach as in participatory design, but the innovation and design processes are more focused on the shared meanings making typical for dialogical process. The voice of children (as well as other actors) is heard and their assumptions become shared as well as challenged while asking and answering investigative type of questions regarding wellbeing. At the same time, strengths and relationship capabilities are increased while outstandingly praising every small step towards the desired, positive future. Digital technology is seen as potential enabler of the envisioned future, i.e. as part of the solution. Typical for a therapeutic process, the process is goal-directed and focuses on coaching and supporting the change needed in those involved in order to live happier life. Finally, we want to highlight the potential of design as a way to encourage participants to play around with their potential scenarios and visions of positive future, again with reflective thinking and discussions in situ playing a significant role as well as experimenting with the design outcomes and exploring their potential.

As is obvious, we do not suggest CHI to utilize the solution-focused approach literally; instead, we highlight some core issues that we think form foundation principles for the future therapy-based participatory design approach. First, instead of problem-based approach, we suggest an approach focused on social behavior opposite of bullying: instead of decreasing or preventing undesired behavior, it is suggested to focus on favorable behavior such as promoting friendships and compassion, respecting each other as well as supporting and helping each other [155]. We suggest trying to avoid using the concept of "bullying" in everything done. In addition, above mentioned interventionist approach with collaboration and teamwork are highlighted. The focus is to be on bottom-up participatory approach, where children's own voices are heard, with the aim that all school children are happy. Nobody is judged (as a bully or a victim); instead, everyone is considered capable to find solutions for making the school a happy place for all where everyone is helping others to feel good and to enjoy their stay. Therefore, all children are considered potential participants in this process. Following the idea of a "support group for the suffering child" [155] we recommend focusing on the group effort, all children being seen as capable to brainstorm and codesign for "better" future. We would like to encourage schoolchildren to think "how they can help those who are not feeling good at school to feel better?"

Young [155] introduces a gradual process which we consider similar to an iterative design process. First, we would like to encourage children to brainstorm for the enjoyable school of the future where everyone feels happy. Next, in line with Young's "support group" taking new ideas into practice, we encourage children to test their ideas in practice before moving to the following steps in the design process. The importance of reflection in and after action is to be highlighted. Positive feedback is to be given frequently [37]. Following the solution-focused approach, we want to keep discussions focused on the future instead of the present. We also aim for as detailed discussions about the future as possible with the support of solution-focused inquiring questions. We consider this as one of the most important guidelines when coaching and supporting the design process; to sensitively direct discussions towards future whenever they seem to fall into problems. It is also important

to understand that we should not intentionally avoid discussions about bullying. In situations when the participants feel the need to describe the problems they have had; one needs to let them do so. However, we do not want to discuss these problems further in detail, instead, we turn the focus into future where these problems have been solved. While doing this, similar to solution-focused therapy approach, we value all the attempts that have already been done towards solutions, all the practices that are already working, including positive deviations [37]. We might even study the details of those positive deviations especially when designing digital technology to enhance them. We also want to consider the use of different type of scaling questions when possible [37]. For example, after each design session we could ask how well the solution works now and how to make it even better. Finally, we want to highlight the usefulness of "miracle question" and the questions following that [37]. In the miracle question, it is expected that during sleep a miracle happens and the problem is gone. Then, we start to ask several questions pointing to the details by which people become aware of the change that has happened due to the miracle; how to recognize the difference, who recognizes what etc. In addition, we would like to highlight the importance of right kind of questions when envisioning the future. Questions highlighting relationships and interaction between people involved are important and useful [37]: we want our participants to consider who the people involved are and how each of them sees things after the potential changes.

We wish to acknowledge also recent developments in the field of solution-focused therapy. The strength-oriented techniques and the method of "co-construction of meaning" used for building solutions with clients picture strong in solution-focused therapy, while there is a need to understand better the way the approach uses the co-construction process and how to facilitate this process [52]. Furthermore, the impact of the collaborative, co-constructive discussion approach, described as "client-led language", making the client feeling understood and cared for, for a meaningful change process should be studied further [52]. All in all, we think these paths for future work within solution-focused therapy reveal potential for transdisciplinary gains when combined with human-centered and participatory approaches within HCI research.

5.3 Ethics Underscored

We wish to emphasize that we are dealing with a very sensitive topic with many ethical issues involved. This is partly addressed by the literature reviewed, while there is still room for elaboration. The literature shows there are solutions developed for monitoring bullies and students at risk for being bullied as well as solutions detecting children's facial expressions and alerting adults when identifying abnormal behavior. The goal of such solutions is indeed valuable, i.e. prevention of bullying and safeguarding of children, but there are also risks of stigmatizing and of advocating a true surveillance society with all our facial expressions being constantly monitored by authorities with alerting mechanisms in place. Moreover, one common pitfall in most of the previous research on bullying is the limited focus on what makes a bully – addressing the potential factors that can increase the likelihood of a child becoming a bully. Instead, alarmingly, technology mediated interventions, especially those dealing with cyberbullying and surveillance, are

geared towards labeling individuals – as a bully or a victim, possibly reducing their identities to specific instances, which we speculate can further propagate feeling of and stigma around victimization for the victim and limit avenues of reformation or getting help for the bully. There is an alarming dynamic identified around those formerly bullied becoming bullies. Collective action and responsibility need to be taken to prevent this from happening. Finally, we wish to highlight that we do not recommend solution-focused therapy use by non-expert CHI researchers. We have adopted ideas and inspiration from solution-focused therapy, while we acknowledge its proper use requires extensive expertise.

6 CONCLUSIONS

In this study we addressed an unfortunately common and a complex phenomenon of bullying through conducting a critical literature review on studies tackling bullying in the lives of children, in the context of and/or by the means of design and technology, covering CHI as well as related computing fields, being inspired by the strong body of knowledge within human sciences. We reported what and how has been done so far to handle this troublesome and widespread phenomenon, revealed interesting underlying assumptions about design, technology and human agency in the literature as well as suggested how to move the field forward with a combination of solution-focused therapy, technology mediated interventions and participatory design.

We acknowledge that the literature review has several limitations. We excluded studies on adults, even if adults most certainly experience as well as suffer from bullying equally to children. Moreover, we did not include studies on the nature, extent, causes or consequences of bullying in children's lives – our focus was on studies working against bullying, not on studies only empirically examining it. Some of the papers touched upon the causes and consequences of bullying, but it would require other reviews (on other disciplines than HCI) to be able to say something substantial about these topics. Furthermore, we did not specifically examine the effects of children's age on the results. We note that the majority of the studies addressed school aged children (K-12), while pre-school aged children received little attention (see the Appendix). Additionally, we did not take into account the effect of gender, if reported in the studies at all. Demographic factors deserve more thorough treatment in the future. As for limitations, further, we did not concentrate much on contextual factors in bullying. We acknowledge cultural issues play a role in bullying as well as in interventions designed against it: cultural contexts shapes what is considered as bullying and what is considered as appropriate in dealing with it. According to our review, bullying research seems to be heavily concentrated on the Western world. In this literature review most of the studies were conducted in European countries or in North America. However, there was also some cultural variety as some studies conducted in Asia, Australia, Middle East and South America were included as well. Moreover, many studies examined English language social media data that can be considered global. However, studies in the context of Global South or developing countries were very limited. Further studies in these contexts are warmly welcomed. Overall, our dataset addressed cultural issues in the sense of variety of countries and continents, while we

acknowledge cultural aspects in bullying deserve a more thorough treatment and argue for culture specific guidance for future interventions against bullying, in CHI as well as elsewhere. We also acknowledge that bullying as a concept is closely related to concepts such as violence and aggression, which were not specifically examined in our literature review, even if touched upon in many studies. Some even claim that bullying is too mild of a concept and that one should always use the concept of violence instead of bullying to make visible the seriousness and harmfulness of the phenomenon we are dealing with. We will explore the relations between these concepts further in the future. We also invite the CHI community to continue examining how aggression and violence picture in the CHI discourse, how those are impairing the lives of adults and children alike and how design, technology, and therapy could make a difference.

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APPENDICES

Appendix A lists the included studies, the countries in which the studies were conducted, the main methods for data collection used for studying bullying, the age categories of children addressed in the studies and the main foci of the solutions proposed for tackling bullying.

Reference	Country	Methods	Age category	Solution
[1]	USA	Interviews	Adolescent (ages 13–19)	-
[2]	NA	Reviewing other studies	Wider age group	-
[3]	NA	NA	Primary school-aged child (ages 6–12 years)	Technology
[4]	USA	Questionnaire	Over 18 year olds	-
[5]	USA	Creative/reflection based methods	Adolescent (ages 13–19)	Design
[7]	NA	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[8]	USA	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design, technology
[9]	USA	Interviews	Primary school-aged child (ages 6–12 years)	-
[10]	Sweden	Questionnaire	Adolescent (ages 13–19)	-
[11]	Spain	Questionnaire	Adolescent (ages 13–19)	-
[12]	Canada	Questionnaire	Wider age group	-
[13]	NA	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[14]	Canada	Questionnaire	Adolescent (ages 13–19)	-
[15]	NA	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[16]	USA	Creative/reflection based methods	Wider age group	Design
[17]	NA	Reviewing other studies	Age not mentioned	-
[18]	NA	NA	Wider age group	Technology
[19]	USA	Questionnaire	Adolescent (ages 13–19)	-
[20]	Spain	Questionnaire	Over 18 year olds	Technology
[21]	NA	Reviewing other studies	Wider age group	Technology
[22]	Spain	Questionnaire	Adolescent (ages 13–19)	Technology
[23]	Australia	Questionnaire	Wider age group	-
[25]	Spain	Questionnaire	Adolescent (ages 13–19)	-
[26]	NA	Reviewing other studies	Wider age group	-
[27]	China, Taiwan, Hong Kong, and Macau	Reviewing other studies	Wider age group	-
[28]	Malaysia	Interviews	Adolescent (ages 13–19)	-
[29]	NA	Technology based methods	Wider age group	Technology
[30]	NA	NA	Age not mentioned	-
[31]	Taiwan	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[32]	Italy	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[33]	NA	Reviewing other studies	Adolescent (ages 13–19)	-
[34]	Portugal	Questionnaire	Adolescent (ages 13–19)	-
[35]	Canada	Technology based methods	Other	Technology
[36]	Ireland	Reviewing other studies	Adolescent (ages 13–19)	-
[38]	NA	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[39]	NA	Questionnaire	Other	-
[40]	Belgium	Questionnaire	Adolescent (ages 13–19)	Technology
[41]	NA	Technology based methods	Age not mentioned	Technology
[42]	China	Questionnaire	Adolescent (ages 13–19)	-
[43]	USA	Other	Age not mentioned	-
[44]	USA	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[45]	UK and Germany	Other	Primary school-aged child (ages 6–12 years)	Technology
[46]	Denmark	Interviews	Primary school-aged child (ages 6–12 years)	Design, technology
[47]	NA	Reviewing other studies	Age not mentioned	-
[48]	Finland	NA	Wider age group	Technology
[49]	NA	Reviewing other studies	Age not mentioned	Technology
[50]	NA	Questionnaire	Wider age group	Technology

Reference	Country	Methods	Age category	Solution
[53]	Finland	Technology based methods	Age not mentioned	Technology
[55]	NA	Interviews	Adolescent (ages 13–19)	-
[56]	Australia	Reviewing other studies	Age not mentioned	-
[57]	UK and Germany	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[58]	UK	Interviews	Primary school-aged child (ages 6–12 years)	Design, technology
[59]	UK and Germany	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[60]	Finland	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[61]	Indonesia	Questionnaire	Preschooler (ages 2–5 years)	-
[62]	Norway	Interviews	Preschooler (ages 2–5 years)	-
[63]	NA	Reviewing other studies	Primary school-aged child (ages 6–12 years)	Technology
[64]	NA	Technology based methods	Age not mentioned	Technology
[65]	USA	Other	Adolescent (ages 13–19)	-
[66]	USA	Other	Primary school-aged child (ages 6–12 years)	Technology
[67]	Taiwan	Questionnaire	Adolescent (ages 13–19)	-
[68]	NA	Technology based methods	Wider age group	Technology
[69]	China	Questionnaire	Adolescent (ages 13–19)	-
[70]	Finland	Questionnaire	Wider age group	-
[71]	Finland	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[72]	USA	Questionnaire	Adolescent (ages 13–19)	-
[73]	Netherlands	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[74]	Canada	Questionnaire	Adolescent (ages 13–19)	-
[75]	South Korea	Interviews	Other	-
[76]	Greece	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[77]	Spain, Malta, UK and Ireland	Questionnaire	Adolescent (ages 13–19)	Technology
[78]	NA	Technology based methods	Wider age group	Technology
[80]	NA	Reviewing other studies	Primary school-aged child (ages 6–12 years)	-
[81]	Austria	Other	Primary school-aged child (ages 6–12 years)	Technology
[82]	France	Interviews	Wider age group	-
[83]	Finland	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[84]	NA	Interviews	Other	Technology
[85]	Israel	Questionnaire	Adolescent (ages 13–19)	-
[86]	Canada	Questionnaire	Adolescent (ages 13–19)	-
[87]	NA	Reviewing other studies	Primary school-aged child (ages 6–12 years)	-
[88]	NA	Technology based methods	Age not mentioned	Technology
[89]	USA	Other	Over 18 year olds	Technology
[90]	NA	Reviewing other studies	Adolescent (ages 13–19)	-
[91]	NA	Technology based methods	Age not mentioned	Technology
[92]	NA	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[93]	NA	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[94]	Greece	Reviewing other studies	Primary school-aged child (ages 6–12 years)	-
[95]	USA	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design, technology
[96]	NA	Reviewing other studies	Adolescent (ages 13–19)	-
[97]	USA	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[98]	Norway	Questionnaire	Wider age group	-
[99]	NA	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[100]	Canada	Interviews	Primary school-aged child (ages 6–12 years)	-
[101]	Australia	NA	Primary school-aged child (ages 6–12 years)	-
[102]	NA	Technology based methods	Age not mentioned	Technology
[103]	NA	Technology based methods	Age not mentioned	Technology
[104]	Malaysia	Questionnaire	Over 18 year olds	Technology
[105]	NA	Other	Primary school-aged child (ages 6–12 years)	Technology

Reference	Country	Methods	Age category	Solution
[106]	Greece	Technology based methods	Wider age group	Technology
[107]	NA	Reviewing other studies	Age not mentioned	Technology
[109]	Norway and USA	Questionnaire	Age not mentioned	-
[110]	Norway and USA	Reviewing other studies	Age not mentioned	-
[111]	Japan	Technology based methods	Primary school-aged child (ages 6–12 years)	Technology
[112]	Italy	Questionnaire	Adolescent (ages 13–19)	-
[113]	Japan	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design, technology
[114]	Portugal	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[115]	Argentina	Questionnaire	Adolescent (ages 13–19)	-
[117]	Canada	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[118]	Italy	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design, technology
[119]	Italy	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design, technology
[120]	Turkey	Questionnaire	Adolescent (ages 13–19)	-
[121]	NA	NA	Age not mentioned	Technology
[122]	Finland	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[123]	Colombia	Technology based methods	Age not mentioned	Technology
[124]	NA	Reviewing other studies	Preschooler (ages 2–5 years)	-
[125]	NA	Technology based methods	Adolescent (ages 13–19)	Technology
[126]	Australia	Interviews	Adolescent (ages 13–19)	-
[127]	Cyprus	Other	Primary school-aged child (ages 6–12 years)	-
[128]	NA	Technology based methods	Age not mentioned	Technology
[129]	Australia	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[130]	Sweden	Reviewing other studies	Adolescent (ages 13–19)	-
[131]	South Korea	Questionnaire	Adolescent (ages 13–19)	-
[132]	NA	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[133]	NA	Questionnaire	Other	Technology
[134]	Australia	Technology based methods	Primary school-aged child (ages 6–12 years)	-
[135]	NA	Technology based methods	Age not mentioned	Technology
[136]	USA	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[137]	USA	Interviews	Adolescent (ages 13–19)	Technology
[138]	NA	Creative/reflection based methods	Adolescent (ages 13–19)	Design, technology
[139]	USA	Technology based methods	Wider age group	Technology
[140]	NA	Reviewing other studies	Wider age group	-
[141]	NA	NA	Age not mentioned	Technology
[142]	Belgium	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[143]	Belgium	Creative/reflection based methods	Primary school-aged child (ages 6–12 years)	Design
[144]	Germany and UK	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[145]	Thailand	Questionnaire	Adolescent (ages 13–19)	-
[146]	UK and Germany	Questionnaire	Primary school-aged child (ages 6–12 years)	Technology
[147]	USA	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[148]	NA	Reviewing other studies	Wider age group	-
[149]	NA	Technology based methods	Age not mentioned	Technology
[150]	Finland	Questionnaire	Wider age group	-
[151]	Finland	Technology based methods	Age not mentioned	Technology
[152]	NA	Technology based methods	Other	Technology
[153]	Japan	Questionnaire	Primary school-aged child (ages 6–12 years)	-
[154]	NA	NA	Primary school-aged child (ages 6–12 years)	Technology
[151]	China	Technology based methods	Preschooler (ages 2–5 years)	Technology