This is the authors' accepted manuscript of the article, which has been published in
ACM Transactions on Accessible Computing, 2020, 13(3), 13.
The final published version at: https://doi.org/10.1145/3396076.

Socio-Technical Aspirations for Children with Special Needs: A Study in Two Locations–India and Finland

Sumita Sharma, University of Oulu, Finland
Tero Avellan and Juhani Linna, Tampere University, Finland
Krishnaveni Achary, University of Delhi, India
Markku Turunen and Jaakko Hakulinen, Tampere University, Finland
Blessin Varkey, Tamana NGO, India

Society's expectations and assistance for children with special needs is rooted in its cultural, societal and political backdrop. Previous work on the role of culture on assistive or adaptive technology design for children with special needs identified a three-part framework: lifestyle, socio-technical infrastructure, and monetary and informational resources. Through our work in India, we proposed a fourth dimension to this framework— socio-technical aspirations. We defined socio-technical aspirations as the individual or community driven ambition and desire to own or use a specific technology for either personal benefit or societal acceptance, or both. In Finland, we interviewed four parents of children enrolled in a rehabilitation program, with the aim to understand their expectations from and current usage of technology. Findings from Finland reveal a desire for technology for children with special needs to be more engaging than what is currently available. We also identified several attributes that can contribute to socio-technical aspirations in a given context, including but not limited to: the level of inclusiveness supported in the school, which directly affects how technology is viewed with respect to the social acceptance it provides; the socio-technical aspirations of the child, and how they are perceived and met by the parents and teachers; and previous technology experience of the various stakeholders involved in raising a child with special needs, which determines their attitude towards technology for not only for themselves but also for the child. In this paper, we validate the dimension of socio-technical aspirations to strengthen our case for incorporating stakeholder's socio-technical aspirations for technology designed or adapted for children with special needs.

CCS Concepts: • **Human-centered computing** → *Accessibility theory, concepts and paradigms*; *HCI theory, concepts and models*.

Additional Key Words and Phrases: Socio-technical Aspirations, Children with Special Needs, Cross-cultural Studies, Assistive Technology Framework

Authors' addresses:
Sumita Sharma, sumita.sharma@oulu.fi, INTERACT Research Unit, University of Oulu, Oulu, Finland ; Tero Avellan, tero.avellan@tuni.fi and Juhani Linna, juhani.linna@tuni.fi, Faculty of Information Technology and Communication Sciences (ITC), Tampere University, Tampere, Finland ; Krishnaveni Achary, krishnaveni.achary@gmail.com, Lady Irwin College, University of Delhi, New Delhi, India ; Markku Turunen, markku.turunen@tuni.fi and Jaakko Hakulinen, jaakko.hakulinen@tuni.fi, Faculty of ITC, Tampere University, Tampere, Finland ; Blessin Varkey, blessinvarkey@gmail.com, Research, Tamana NGO, New Delhi, India.

1 INTRODUCTION

The *experience* of children with special needs, and the stakeholders involved in raising them, is rooted in the cultural, societal and political makeup of their community [6, 17]. This implies that an individual's cultural, religious, and socio-economic background guides what is available and desired: from diagnosis, to assessment, to interventions, and to technology. This further defines societal expectations and assistance for individuals with special needs. In this paper, we use the term *children with special needs* to refer to children with intellectual and/or cognitive disabilities, including but not limited to autism. Autism is a neuro-developmental disorder in which individuals experience varying levels of cognitive, social, and behavioral challenges, and is commonly referred to as Autism Spectrum Disorder (ASD) [4]. The role of culture and its implications towards assistive or adaptive technology design was studied by Boujarwah et al. [6], in four countries—Kuwait, Pakistan, South Korea, and USA. They define a three-part framework for assistive technology design: *lifestyle*, incorporating family structure, linguistic environment, and religion; *socio-technical infrastructure*, consisting of technology and civic infrastructure, and programs and services available for individuals with autism and other intellectual disabilities; and *monetary and informational resources* accessible to individuals and their families. For instance, in Kuwait and Pakistan, families hire domestic staff to assist with the day to day care of a child with special needs making scheduling of tasks easier. However, comparing this with South Korea or USA, the authors state that mothers found it difficult to keep a steady job due to the high childcare demands [6]. This implies that applications designed to streamline the day to day scheduling process for a child with special needs to alleviate the workload of mothers might be more desirable in South Korea or USA rather than Kuwait or Pakistan.

Based on our previous work at a special school in New Delhi [40], we proposed a fourth dimension to Boujarwah et al.'s framework [6]—*socio-technical aspirations*. We defined socio-technical aspirations as the individual or community driven ambition and desire to own or use a specific technology for either personal benefit or societal acceptance, or both (ibid). We argued for incorporating socio-technical aspirations of different stakeholders, e.g. parents, care-givers, therapists, and teachers to motivate technology design, acceptance, and adoption for children with special needs. Our previous work, presented at the ASSETS 2018 conference [40], consisted of a two-part study. In the first part, we used the Fitbit Flex activity trackers to motivate children with autism in a special school in New Delhi towards everyday physical activity, namely walking. In the second part, we interviewed the parents, occupational therapist, and researchers, several of whom were a part of the Fitbit study, to understand their overall perceptions towards technology use for children with special needs. The goal of the studies was to understand how mainstream technology is adapted and adopted within the context of a special school in New Delhi and whether fitness trackers could encourage physical activity outside of the school environment. There were several challenges towards using Fitbits in the first study, including sensory sensitivities, parents' fear of their children losing the devices, and other technical limitations. The parents involved in the Fitbit study were still nonetheless enthusiastic about using it and commented on the social acceptance it provided. The paper was titled, "Wow! You're wearing a Fitbit, you're a young boy now", based on a parent who exclaimed that their child loved to wear the Fitbit band because of the social *appreciation* they received, which in turn increased their *confidence* and made them *feel happy*.

In this paper, we extend our ASSETS 2018 work [40] by replicating the second part of the Indian study in Finland, that is, conducting interviews with four Finnish parents of children with special needs in March–April 2019 and discussing our findings from the interviews in the two locations. However, the Fitbit study from the ASSETS 2018 paper is not be repeated here. Our motivation for studying socio-technical aspirations in different contexts stems from our previous work on

technological interventions with children with special needs in India and Finland. Participants for the two studies presented in this paper were recruited from environments familiar to the authors to avoid misinterpretations in the analysis. We also identify the different aspects that determine socio-technical aspirations in a given culture—the degree of inclusiveness provided by a school, e.g. special schools versus integrated school; a child's own aspirations as understood by parents and teachers, e.g., how they wish to spend their time; and previous technology experience of the stakeholders, which determines how closely they follow the latest trends in technology for themselves and the child. These findings pave the way towards designing technology-based interventions that are adopted in the long term, given the intrinsic nature of aspirations. Further, ongoing work with marginalized or under-served communities, such as within HCI for Development, has already identified the need for an aspiration-based design model to improve sustainability [47].

We note here that the context of culture itself is dynamic and evolving, therefore "the assumption that individuals have a single cultural background is problematic, especially in the face of contemporary patterns of globalization and transnationalisms" [24]. Further, cultural aspects of the locations are too complex to deconstruct and critically analyse based on the two short studies presented in this paper, but there is a brief mentioned of a few to scaffold the findings from that location. However, comparisons between the cultural contexts is out of scope for this work. Our main contribution is to highlight the nature and relevance of socio-technical aspirations in the Indian and Finnish cohorts. This paper presents findings to build a case for extending Boujarwah et al.'s framework [8] to include the dimension of socio-technical aspirations as a mechanism to determine stakeholder's expectations and desires towards technology. This enables researchers and designers ti be better equipped to develop technology that is adopted in the long term and thus sustainable.

This paper is organized as follows: Section 2 presents the related work in this domain starting with the state of the art in educational technology for children with special needs in India and Finland, a simplified cultural lens towards Indian context and Finnish context, and a summary Boujarwah et al.'s work [6]. Section 3 describes the study methodology, including the procedure, participant demographics in India and Finland, and the interview framework. Section 4 presents the results of the study in India and Finland. Section 5 presents a discussion of the results and details the key findings, and Section 6 concludes the work.

2 RELATED WORK

The *experience of intellectual disabilities*, including autism, is influenced by the cultural, social, and economical aspects of a place and thus varies widely across the world [6, 17, 51]. Previous extensive work by Boujarwah et al. followed a stakeholder inclusive approach to identify challenges in social interactions and behaviors for individuals with autism [5, 8, 28] and design crowd-sourced social scripts and resolutions for supporting them through various socio-cultural interactions [7, 36]. Further, mapping the ecosystem of a child with special needs has also been achieved in the context of designing applications for online social interactions [20–22]. Our work extends previous work within the ecosystem system of an individual with special needs by incorporating stakeholder aspirations in the design of technology. There is a large variation between the two locations of our study in terms of educational and health policies, and practices and implementation of these policies. Further, national policies also affect the process of diagnosis of a condition, access to relevant information and interventions, and available support. Within the context of the work presented in the paper, we first provide a brief overview of technology and education for children with special needs in India and Finland. We then highlight the cultural contexts of the two locations, and lastly, summarize Boujarwah et al.'s framework for assistive technology design [6].

2.1 Technology in Special Needs Education in India

The Indian government has concretely defined policies for integrated education in schools[1] and declared the Right of Children to Free and Compulsory Education (RTE) Act in 2009[2]. Other government initiatives include the National Institute of Open Schooling (NIOS)[3], an organization which offers both basic education and vocational training in more flexible terms compared to mainstream curricula, and students can take exams at their own pace. NIOS is specifically designed for *"sustainable inclusive learning with universal and flexible access to quality school education and skill development"* (ibid). However, the education ecosystem in India is complex with a combination of public, private, integrated, and special schools, with further variations across states. Moreover, there are still several challenges towards how these policies are implemented at the grass-root levels.

A nation wide survey on children who were *out-of-school* between the ages of 6–13 years in 2014 revealed that number *"among the disabled population remain much higher than the national average...an estimated 28.07 percent children with special needs are out of school"*[44]. The 2015–2016 School Education in India report [30] states that of the total number of children enrolled in public schools across India, children with one or more disabilities constitute only 1.18 percent in primary schools (grades 1–5th), 1.13 percent in upper primary (grades 6–8th), 0.56 percent in secondary school (grades 9–10th), and 0.25 in higher secondary (grades 11–12th). Recent data on enrollment in special schools across the country was difficult to find, but a draft report commissioned by UNESCO in 2009 [43] states that only 11 percent of children with disabilities, in the 5–18 years age group living in urban environments, were enrolled in a special school. Further, it lists the number of special schools at 2500 in the year 2000. This study also states the challenges in conducing surveys across India, where culture, caste, religion, social and gender norms, all play a role in the methods available for collection and in self-reporting of data.

A qualitative study with 11 private schools in the Indian city of Kolkata revealed "variations in conceptualization of inclusive education...not only between school staff and policy documents, but also between the different policies" [45]. A study on teacher's attitudes towards disability and inclusive education in Mumbai stated that without prior acquaintance with a person with disabilities, teachers at mainstream schools meant to integrate children with special needs were unable to understand their needs [31]. Similarly, in a study in Kolkata that examined the perspectives of different stakeholders towards autism in private mainstream integrated schools, it was evident that most of the teachers were not aware of autism before having met a student with the diagnosis [46]. Furthermore, there is a culturally misguided attitude towards individuals with disabilities in India [2, 12, 13], and an autism diagnosis in India is delayed between 6–9 months when compared with the US [12]. With a growing awareness, advocacy, and interest in providing quality education to children with special needs, the Rehabilitation Council of India (RCI)[4] upgraded their one year Diploma course in Special Education to a two-year Bachelors' in Special Education, with the possibility of an integrated Masters in Special Education within three years, from 2015[5]. This change is expected to not only train special education teachers more but to attract more talent towards this occupation. RCI is responsible for maintaining a central registry and providing education to professionals working in rehabilitation and special education. For comparison, a bachelor's

[1] https://www.mhrd.gov.in/iedss
[2] https://mhrd.gov.in/rte
[3] https://www.nios.ac.in/
[4] http://www.rehabcouncil.nic.in/
[5] http://www.rehabcouncil.nic.in/writereaddata/B_Ed_Spl_Ed(2)(1).pdf

in Education at the University of Delhi is two-year program[6]. Thus, teacher training for special education has only recently been revised to be at par with a typical specialization degree.

Within a special school environment, there can be several challenges towards introducing technology mediated interventions for children with special needs [2, 41]. This includes resource constrains within the environment, for example, infrastructure and access to electricity. There is also a large digital divide where entire communities, as a consequence of socio-economic background, gender, geography, or education, are excluded from accessing technology. Moreover, technology can be in some cases prohibitively expensive, especially for individual use. Strong cultural barriers for individuals with special needs further lead to a more pronounced digital exclusion even within technology-capable communities. For example, economically stable and educated parents might provide a mobile phone to a typically developed child and but not to a child with special needs [39]. In contrast, special schools can also be highly focused on technology mediated interventions, like the Tamana special schools in New Delhi, India [39, 41] (a typical classrooms of a special school is shown in Figure 1).

Fig. 1. Classrooms at one of the Tamana schools for children with special needs, adapted from [39]

2.2 Technology in Special Needs Education in Finland

In Finland, the ideology is to provide special needs education services at every level of education free of charge. Children with special educational needs are integrated in mainstream education, if possible, or in special needs groups, or both. Most children attend a municipal school near their homes and are supported individually, such that they can successfully complete their education (a typical classroom is shown in Figure 2). In the case of children with severe disabilities, there are basic education special schools and vocational special education institutions. These schools provide more individual training and rehabilitative instruction and guidance [29].

The number of children receiving special education has grown at every level of education. In 2017 at least 29 percent of children in basic education received some support for learning and schooling [14]. The share of those receiving all their education in a special education school is falling. From children receiving special support in basic education, 9.5 percent received all education in a special education school [14]. More than 90 percent of the relevant age group starts general or vocational upper secondary studies after completing the basic education level. In 2016, at least 9 percent of all students in vocational education received some support for learning and schooling, and at least 13 percent of students receiving special support were studying in vocational special education institutions [14, 29].

[6]http://cie.du.ac.in/

Fig. 2. (left) A typical classrooms in a school in Finland and (right) a screenshot of the game Ekapeli Alku

According to the Finnish Basic Education Act [1], every school needs to offer special educational support. Local educational autonomy plays a key role in Finland. Local authorities, most commonly municipalities or joint municipal authorities, have the autonomy to organize special education in various ways [29]. Education providers, mostly schools, are responsible for practical teaching arrangements. Local authorities determine how much autonomy is passed on to schools. Local authorities prepare local curricula (municipality and school-based) that accommodates the educational goals and needs of the local area and each school. The local curricula had to be aligned with the enacted law in relation to special education arrangements [33]. According to Pesonen et al. [33], the legislation in Finland is unique because it is grounded on professional trust such that no enforcement mechanisms were incorporated in the act. Special education teachers qualification requires a five year Master's program with special education as the main subject or a one to two year postgraduate program in special education for persons who already have a teacher qualification and a Master's degree. Finnish teachers are highly qualified [15], having pedagogical autonomy. They can decide themselves the methods of teaching. This means that a lot of innovation can take place without specific national level initiatives to promote it [29]. The role of the teacher is significant in many respects.

However, even when local flexibility can result in favorable educational arrangements in schools and municipalities, it is not the case in all schools and regions [33]. The growing number of children receiving special education reflects not only an increase in the prevalence of learning difficulties, but also the determination of the Finnish education system [14, 50]. In smaller municipalities, various incidental factors can significantly affect the need for special education, and also low socio-economic background [35], therefore, regional differences partially depend on resources. Technology can be a part of the solution to this resource problem. According to Pulkkinen et al. [35], continued efforts are needed to ensure the provision of resources for part-time special education and the use of other forms of early intervention in general education classrooms. Technologies used in special education in Finland can be divided into *assistive technologies*, *communication technologies*, and *learning technologies*. According to Kärnä et al. [25], special education learning technology is generally well known and quite widely used in teaching among teachers and other specialists of education in Finland.

Although, there has not been technology-based curricula [50], the new Finnish curricula in basic education came into force in schools starting in August 2016 introducing the concept of digital competence. Digital competence is defined as how to integrate computer science in basic education. It does not only imply tech-rich learning environments or learning technologies, but is seen as general skills and attitudes needed by everyone for living in the current and future society [34]. According to Pettersson [34], it should be regarded as an organizational task. However, in a

special school environment, there can be several challenges towards introducing technology in the development of the learning environments, including again resource constraints within the environment.

2.3 The Context of the Study Locations

The Indian and Finnish study contexts are quite varied in their social, cultural, and political motivations and policies, e.g. for special education. These variations make it difficult to present a cultural comparison between the two study locations. Instead, we present here the individual contexts and highlight a few known differences that have an affect on the individual's and community's responsibilities of raising a child with special needs. Previous work to build an understanding of cultures includes studies by Hofstede [19] and the World Value Survey[7]. These models of culture, while inherently limited, provide a starting point to under the two different study contexts, the Indian and Finnish national cultures. Looking at Hofstede's dimensions of national cultures [19], namely power-distance and individualism (vs collectivism), we can say that Indian societies when compared with the Nordics, usually have a large power-distance, that is, there is an expectation and acceptance of unequal social status or power distribution. This leads to multiple levels of a social hierarchy, where an authority figure should not be contradicted by virtue of respect. Within a school environment, this would mean that teachers are generally held in very high regards and understood to have authority, and responsibility, to decide on the educational road map for a child. Regardless of the power-distance, the responsibility of teachers and educators to introduce, adapt, and guide technology use for education is almost universal. In the generally collectivist Asian societies, which are focused around group life, there is a heavy reliance on and involvement of extended family, relatives, and close friends for day-to-day life. As also noted by Boujarwah et al. [6], this results in multiple people being involved in and supporting raising a child with special needs, and sharing of responsibilities. On the flip side, for children with special needs, this can translate into extended social participation daily or then extreme social exclusion from the group or community. Of note, with these dimensions of national cultures, it is difficult to capture the influence of increasing access to technology and consequently access to global cultures and media [24].

The World Value Survey (WVS), started in 1981, has multidisciplinary experts conduct surveys and interviews with participants from over a 100 countries in the world from different socio-economic strata to map socio-economical and political trends across cultures. WVS aims to also show the changing dynamics of societies across the decades. The findings are charted on an Inglehart-Welzel Cultural Map [23] against two main value-dimensions understood to contain the variations between cultures. The first dimensions is *traditional values versus secular-rational values*, where the more traditional a society, the more it places an emphasis on religion, adherence to authority, and traditional family values. On the other end, there are societies that are seemingly opposite, with less emphasis on religion and authority. The second dimension is *survival values versus self-expression values*, where survival values place an emphasis on "economic and physical security" and "linked to low levels of trust and tolerance" [23]. Self-expression values place an emphasis on openness, tolerance, equality, and civic and political participation. From the WVS, it seems that Finland has higher emphasis on secular-rational and self-expression values as compared with India. However, India is also globally positioned almost at the center for these dimensions. In the last two decades, India has moved from survival to self-expression values, indicating its changing socio-cultural and political dynamics. Given the vast cultural, geographical, economical,

[7] http://www.worldvaluessurvey.org

and political landscape of India, it is almost impossible to aggregate all its states and societies into one data point. However, for the purpose of this work, this generalization may suffice.

There is an undeniable technology driven desire and aspiration that is common across cultures—*entertainment*. The need to be entertained has connected seemingly different cultures. Additionally, previous work on understanding the technical aspirations of communities considered currently underserved, or from resource constraint environments, emphasizes the need to consider people's desire for online leisure, including romance, play, and entertainment [3]. This inherently universal desire for entertainment may also extend to the two study contexts and to education. *Edutainment* or *serious games* can be considered a distinct form of educational technology [16, 37] that covers a broad range of applications, from web-applications to even fully immersive 3D environments, pairing various game features such as challenge, fantasy, complexity, and control, to increase the motivational appeal of learning and engaging children [16]. However, the ever changing experience of culture through technology, media, and even travel, requires further research.

2.4 Summary of Boujarwah et al.'s Framework

Boujarwah et al. [6] conducted a cross-cultural study with individuals associated with autism, and other intellectual disabilities, to understand their expectations and perceptions of assistive technologies. The study was conducted across four cities, one each in Kuwait, Pakistan, South Korea, and the United States, by researchers native to the country. It included multiple observational sessions at special schools, vocational and autism centers, and group homes, followed by semi-structured interviews with a total of 107 teachers, parents, therapists, and other individuals in administrative roles. The interviews included questions at an individual level, regarding the child's daily activities, and at the group level, regarding the social, cultural, and practical experiences of the children and the stakeholders that surround them. For instance, the researchers asked about ongoing or available interventions for social, life, and vocation skill development, information seeking and gathering behaviors, and long-term goals. This work provides a first-hand understanding of how culture affects the experience of autism and subsequently expectations from assistive or adaptive technology. For example, in Kuwait and Pakistan, it is culturally acceptable, and in some cases preferable, for individuals to live with their parents in a joint family. Thus, in those contexts, the importance of living independently for individuals with autism, and therefore, the importance of designing assistive technologies that support independent living, were not as desirable as for the participants from the United States.

Based on their study, Boujarwah et al. [6] identified a three-pronged framework for assisitve technology design—*life-style, socio-technical infrastructure,* and *monetary and informational resources.* By lifestyle, they refer to family and social structures surrounding an individual with autism, where people may play different roles with varying levels of involvement in the day-to-day life of the individual. Lifestyle also includes the linguistic environment, which affects social interaction and also education, for instance, for families in Kuwait the language at school can be English, at home Arabic, and a third one spoken can be spoken the domestic help. From a designers perspective, applications that support daily scheduling of activities should be designed according to the different family and social structures across cultures, which has a direct affect on how the responsibilities are shared among individuals. Therefore, a scheduling application would have different requirement for users in Kuwait, where they is a larger group of people involved in raising a child with special needs, compared to the United States, where possibly only the parents are involved directly. Socio-technical infrastructure refers to the infrastructure and services that are available to a community, which can potentially determine the desired life-skills to teach. For instance, given South Korea's efficient and reliable public transportation system, its navigation was deemed an important life skill for being independent. While in the United States there was a focus on the possibility of learning

how to drive, given its car culture. Monetary and informational resources refer to the current access to resources and services for a given community based on its socio-economic and regional status. Access to many special needs schools, for instance in Pakistan, South Korea, and the United States, was deemed expensive and affordable only to the most wealthy.

While Bourjarwah's dimension of socio-technical infrastructure refers explicitly to the now and here in terms of technology access and use, providing a mechanism to identify short-term goals of the stakeholders. Socio-technical aspirations, however, are forward looking with a focus on identifying the gaps between availability vs expectations and the desires of the stakeholders when it comes to technology access and use. The desires themselves can vary depending on the socio-cultural and socio-economic makeup of the community, educational policies and practices, stakeholder's technology experience, and the child's own aspirations.

3 METHODOLOGY

The aim of the study was to examine the adoption and use of technology in two countries in the context of special education, and to contrast the findings with Boujarwah et al.'s framework. Semi-structured interviews were chosen as the most appropriate data collection method with both the Indian and the Finnish cohort, giving us both the structure needed for comparing and contrasting the data, and the freedom to probe or even improvise where appropriate. Same interview framework was followed in both countries. In authors opinion, it is important to choose cohorts that represented similar socioeconomic status, and participants whose children's educational environment is similar to some extent, given the vast diversity of circumstances in special education, especially in India. In our case, Indian participants (n=5) consisted of parents, educators, and an occupation therapist, several of whom participated in a study involving Fitbit Flex activity trackers for children with autism. Finnish participants (n=4) were parents whose children attended an after school rehabilitation program for children with ADHD. The differences in the two cohorts and their socio-cultural contexts make it difficult to directly compare the results. However, the two cohorts broadly represent the various stakeholders involved in raising a child with special needs, which is the overall focus of this work.

3.1 Participant Recruitment

For the interviews, five participants from India and four participants from Finland were recruited. Their demographics are shown in Table 1. Written (signed) informed consent was taken by all the participants prior to the interviews for this work in both locations. In India, Tamana administration granted permission for the study conducted in their premises, which consists two parts. In the first part, children with autism and their parents were invited to use the Fitbit Flex (wrist band) activity tracker to monitor their daily step count for a period of ten days [40]. In the second part, several of the stakeholders involved in the Fitbit study (researchers, parents, therapist) were invited for an interview while other participants were recruited opportunistically at the school premises by the interviewer. Tamana has been at the forefront of developing and studying interactive technology for children with special needs in New Delhi. This includes several gesture-based applications to promote social interaction among children with autism and their typically developed peers or caregivers.

For the Finnish cohort, the university ethics board granted permission for the project (*Embodied games for cognitive and behavioral rehabilitation of attention deficit/hyperactivity disorder*) in Finland, of which this work was a part. As the name suggests, in this project a gesture-based interactive game for children with ADHD/ADD was designed, developed, and deployed at the psychology clinic in the university premises. Participants for this study were recruited by sending an email to the parents of the children participating in the clinical study of the gesture-based game.

3.2 Participant demographics

Upon admission to Tamana, the organization's psychologists and therapists diagnose the child using the Autism Diagnostic Observation Schedule (ADOS) [26] and the Childhood Autism Rating Scale (CARS) [38]. They then evaluate each child's progress annually, or biyearly. The children attending Tamana School of Hope usually have a diagnosis of medium-low functioning autism (by experts at Tamana), indicating that as they have low motivation for social interaction and communication (both verbal and non-verbal) and display various isolating behaviors and interests. We note here that in India, the government provides a list of credible centers and organizations that can certify that an individual has a disability based on a government provided list of disabilities. Over the years, this list has been expanded, for instance, 10 years ago autism was not a part of the list. Although we do not have access to this list, the Indian government's National Health Portal for citizens has a list of diseases[8]. A government issued disability certificate is required to obtain admission at any of the Tamana schools, but the experts at Tamana maintain their own diagnosis, which is what we are refering to in this paper.

In India, participants were adults involved in the research, therapy and education activities at Tamana School of Hope. The five participants included two parents with children with autism (1M, 1F), two researchers (1M, 1F) responsible for all technology driven interventions at the school, and the school's occupational therapist (1F). The participants age varied from 27–57 years, with three participants having a specialized Bachelor's degree, one with a PhD, with one who did not provide this information. Three of them worked at the school while one was a homemaker and one did not provide this information. All five participants used a smartphone, four used a tablet, four used computers, and while all five participants had internet access at their home and four had it at their place of work.

In Finland, an educator at a public school has the authority to recommend that a child receive special interventions in addition to regular integrated schooling. At the first level the needs of the child are educationally determined and not based on a psychological or medical needs. However, the Finnish Basic Education Act [1, 33] recommends a psychological or medical evaluation, but does not require it. This implies that experts and authorities at the school have diagnosed a special needs child although only a medical doctor is allowed to make a formal diagnosis. In this work, four parents (4F) were recruited from an ongoing therapeutic and learning intervention employing gesture-based gaming for rehabilitation of children with special needs, more specifically ADHD, at the Psychology clinic at the university. The child's formal diagnosis was either not yet available or not revealed. Participants age varied from 37–47 years old, with all four participants working as professionals with a specialization, and three having a Master's degree. All four participants used a smartphone, a tablet, and computers having internet access at their home and work.

3.3 Interviews

The interview framework consisted of economic (e.g. disposable assets, economic responsibilities), socio-cultural (e.g. social practices between parent and child), organizational (e.g. rules, regulations), and environmental (e.g. infrastructure) perspectives, but emphasized respondent's personal experiences and everyday work and life with the children with special needs. The different stakeholders brought in their own digital realities and aspirations. Similar categorization of perspectives has been used by e.g. Brewer, who writes about technical, cultural, and environmental challenges in reducing the digital divide [11]. In comparison to Boujarwah et al., the focus was more on the everyday technology interaction and less on the cultural impact. The questions were also designed

[8]https://www.nhp.gov.in/disease-a-z and https://www.nhp.gov.in/disease/neurological/autism

Table 1. Participant Demographics

Country	Age	Gender	Relation to Child with Special Needs	Child's Age
India	27	M	Researcher	N/A
India	36	F	Researcher	N/A
India	N/A	F	Parent	9
India	27	F	Therapist	N/A
India	57	M	Parent	20
Finland	37	F	Parent	12
Finland	41	F	Parent	9
Finland	47	F	Parent	10
Finland	45	F	Parent	11

to uncover three broad themes—current technology usage at the personal and education level, challenges towards technology access and usage, and expectations or aspirations for the future.

The interviews in India were conducted at the Tamana School of Hope, New Delhi, India, in the summer of 2016. The interviews in Finland were conducted in Tampere University in March–April 2019. In India, the interviews were conducted by the authors in Hindi or in English, and audio recorded and transcribed into English for analysis. In Finland, they were conducted in Finnish by the authors, and audio recorded and summarized in English for analysis. The interviews lasted 45–70 minutes, and the participants filled in a background information form prior to the interview. The participants were free to decline from answering the questions or discontinue the interview at any point and without any given reason, however none of them chose to do so.

3.4 Data Analysis

Analysis was conducted by following the principles of thematic analysis and the six steps presented by Braun and Clarke [10]. As the name implies, thematic analysis is a method for finding, analyzing, and describing themes (patterns) that stem from the data. Unlike qualitative analytic methods like conversation analysis or grounded theory, thematic analysis is not tied to a specific theoretical position or framework, allowing for more flexible applications, which was required given the large variations in the two contexts of study—India and Finland. Moreover, the analytical approach allowed us utilize our own expertise in the knowledge creation process—Braun et al [9]. have recently defined this type of thematic analysis as *reflexive thematic analysis*.

In the first phase of the analysis, the Indian interview data was transcribed in English (for the previous paper, in 2017) and Finnish interview data was transcribed in Finnish (in 2019), and then summarized in English. The transcriptions and summaries were done by the authors. In the second phase, initial codes were generated from the data—two authors (re)coded the Indian transcriptions and two coded the Finnish transcriptions. In coding, focus was on the driving and inhibiting factors in technology use. The purpose of coding was not to quantify the transcribed data, but to understand it. In the third and fourth phases, we jointly identified and reviewed themes that defined socio-technical aspirations in different contexts in workshops of three researchers. We frequently compared the Finnish and Indian data, and refined our joint understanding on the most important aspects. We debated whether and in which way the data supported existing knowledge and especially Boujarwah et al.'s framework, and our own previous findings considering socio-technical aspirations. Data from India was re-analyzed, given it was collected more than two years ago. It was agreed that while socio-technical aspirations clearly existed in both countries, they

were (perhaps unsurprisingly) visible in the data in a different way. Therefore, the joint analysis work continued with a focus on themes that would explain how socio-technical aspirations are formed and shaped. Once consensus was reached on the number and contents of the themes, they were defined and named in phase five. The themes were (a) the level of inclusiveness within a school, (b) support for children's aspirations, and (c) previous technology experience of the different stakeholders. In phase six, the results were reported, and are presented next.

4 RESULTS

In this section, the results of the thematic analysis of the Indian and Finnish data is presented, with a short summary at the end. Through the data presented in this section, we emphasis the prevalence of socio-technical aspirations in each cohort and further compare their similarities and differences in such aspirations. However, while socio-technical aspirations reveal themselves differently in each cohort; they still contribute to assistive technology design and adoption that is sustainable in the long term. *It is therefore important to consider socio-technical aspirations as a fluid concept that can take many forms.* Given the small number of participants that were interviewed in this study, it is difficult to attribute the differences in socio-technical aspiration solely on culture. Therefore, we refrain from comparing the data between the Indian and Finnish studies, and conclude the section with a brief summary of the similarities in the findings.

4.1 Indian Stakeholders' Perspectives towards Special Education and Technology

The Indian stakeholders that were interviewed consisted of two parents of children with special needs (I1 and I2), one occupational therapist (I3), and two researchers at the Tamana schools working on incorporating technology mediated interventions (I4 and I5). The responses to the interview framework were grouped into three main categories: current technology access and usage, the challenges faced towards current technology access and usage, and expectations for the future. Next, these responses are summarized and participant quotes are provided (I1–I5).

4.1.1 Current Technology Access and Usage. Almost all participants mentioned using mobile phones, tablets, internet at home and work, and popular applications and services, such as Youtube, Google, WhatsApp, and online banking and shopping. When asked about how they find out about new applications and services, many responded that ask their friends, colleagues, or other family members, or check the application stores, such as Play store for Android. Participants also mentioned looking up information regarding children with special needs online to empower and enable them to make better and more informed decisions for their child's educational and therapeutic needs. *"Personally, I go for play store, and then I get to know the new apps, and then search out for [the] kids, whether it will be beneficial for them" (I2).* Two participants specifically mentioned **getting information on new technology through a male** member in their family or at work.

Within a special school environment, tablets are used quite frequently for educational interventions and also as a reward. For instance, using a tablet first for an intervention for improving cognitive skills, and then at the end of the session, for **playing a game as a reward** for the completing the session. *"Yes, we are using [technology] everyday because it is sustainable. We are using it to expand their attention time, sitting time, to motivate them to learn, even at home for my children, I give technology as a reward" (I4).* Participants also mentioned using a projector and YouTube videos at the school. The school has its own technology innovation lab and they have developed and studied several Kinect-based and Virtual Reality applications. The Microsoft based Hour-of-code[9] was also arranged at the school. Several students are encouraged to take additional specialized computer classes with the school's computer teacher or even outside of the school, for example, to

[9]https://hourofcode.com/us

learn programming or graphic design. The school has also started using Google for Education to assist students with who are registered in the NIOS program at the school: *"We have 30–35 students enrolled in the senior secondary NIOS program. We are giving them email IDs and the platform that Google for Education has provided. Through the platform, in the coming months, we are going to make the child go on the platform and watch the videos, which are being structured and organized by the class teachers, have a look at them. And also upload their students assignments etc" (I5).*

Technology is introduced at the school through the educators, parents, volunteers, and outside connections, such as, other schools or through collaborations with institutions. However, the school administration and leads have the final say on how and when it is incorporated in the school: *"We are also connected to other schools, say at conferences or other places, we see what is working for them. Being a research team, we also study technology and then see how it can benefit our students. New parents and joinees also definitely ask about technology and see how the school uses technology and feel that it is the best" (I4).* One participant mentioned that until 2014, a special educator would mainly have a one year diploma course recognized by the RCI after finishing their K12 schooling. Although they would learn on the job, upgrading of the diploma course to a Bachelor's degree in 2015, should benefit in **attracting a more talented pool towards special education**.

The school specialists are keen to guide parents towards using technology at home for follow-up interventions that support the training at the school. They also share articles and other sources of information regarding children with special needs. This is mainly because awareness regarding neuro-developmental disorders and even mental health is low, even among urban populations. A parent mentioned learning about autism only when their child was diagnosed with it. WhatsApp was the popular choice for educators and parents to connect outside of the school. *"[We] help parents understand how to follow up at home by giving instructions on WhatsApp, taking pictures and videos of the children while they are doing therapy and share with parents via WhatsApp" (I2).*

WhatsApp is also used to connect with the students, where on one hand it promotes learning how to write and on the other, in some cases it amplifies bad language. *"One positive aspect is using WhatsApp to improve writing ability. So some students have a problem in framing sentences and communicating, so now technology is motivating the child to learn how to write, and we are also promoting this. The negative side is that the child picks up random or swear words from friends, but do not know how to use them or where to use them, and the child uses such words in messages to the teachers. So now, we also try to teach moral aspects of the communication" (I4).*

In the home environment, technology was used mainly for fun, such as, listening to music or playing games. However, the educators and parents conflicted in their expectations towards technology usage at home. Parents found it easier to entertain their child by providing them online access, *"[My child] is engrossed in [watching music videos on Youtube], and I can do my own work to do, I don't have to worry about what he is doing" (I1).* While **using technology to entertain or pacify a child was explicitly frowned upon by the school staff**, as it reduced their physical activity or opportunities to socialize. *"They are using it everyday, what I feel like is that children's physical activity level has been reduced" (I2).* And *"the parents have to put in effort to help the child socialize, but the child will have tantrums, and if the parent is unable to handle the tantrums, they would give technology and not persist with the socialization" (I4).*

4.1.2 Challenges Towards Technology Access and Usage. Several challenges regarding access to technology were mentioned by the participants, including previously known issues such as the cost of a device or service, limited or unreliable access to the internet, and keeping up with regular maintenance of the devices, especially at the school. *"There is the technical challenge in maintaining all the devices, the computers, iPads, tablets, charging them, keeping them safe, [software] updates, keeping them in the right way, maintenance increases, and depending on how well they are maintained*

affects how well they are used for learning" (I4). The participants also mentioned a fear of the children mishandling the devices by throwing them, breaking them, or losing them, *"As of now, most parents would not even give a phone or tablet to the child because they were in constant fear of the child throwing the tablet or phone away" (I5).*

A lack of content was not stated as a challenge towards technology usage, even when asked explicitly, but **a lack of information towards available content was a big issue**. *"There is content out there that is applicable and relevant but for us, the main challenge was finding it" (I4).* Further, it was unclear whose responsibility it is provide this information. The parents expected the school educators to guide them better, *"Teachers do not guide, just show us the iPads apps to use" (I3),* even though the educators discussed guiding and sharing information with the parents on a regular basis.

There were also issues regarding misinformation, especially for non-urban populations where parents were being asked to pay exorbitant fees for specialized therapies that are not at par with the quality provided at more resourceful urban centers: *"Because a lot of the parents do not know where to go when they have a special child, they probably go to a therapist recommended by a doctor. When they go there, a lot of the therapists...might charge a hefty sum for something that is not worth that much. [There is] a lot of misinformation and misguidance" (I5).* One way suggested to **counter this misinformation and misguidance was by parents becoming more proactive towards searching for information online**, *"Knowing how to use the internet [is important] for parents who have just started with a special needs child—they can start with the application themselves at home, and be the first educators for their kid" (I5).*

Several of the participants mentioned that **technology is increasing social isolation**, for the child, and for everyone in general. *"My son plays games on the [tablet], he is improving. But there should be a limit. The child should not forget the world and focus only on the tablet. That is not right" (I3).* Technology addiction was mentioned as a growing concern. Technology was further seen to create a communication gap between people as it loses the richness of interpersonal conversations: *"Because I feel like I can convey my thoughts anytime on WhatsApp, so I am not giving priority to people actually around me, and by not giving this priority, people feel isolated and left out" (I4).* Technology was also seen as **disrupting the learning process**, as children resort to searching on Google and finding quick solutions, rather than spending time going through books. Another challenge was how technology rewards solutions and not the learning per say. For instance, a child can continue to play a game or use an application at the same level of difficulty if they are unable to progress to the next, as the game or application does not enforce moving on. Or, when working in a classroom, another child can disturb the session and provide the answer, and a reward is still given. Thus, there can be scenarios where a child is rewarded for the wrong behavior: *"Say I am working with one child and another comes and interferes but solves the problem, the technology will appreciate and reward the first child - which is wrong and misleading" (I4).*

Participants were especially concerned about child safety online and they mentioned **challenges towards monitoring and supervising a child's use of technology**. For instance, one participant mentioned that they *"cannot know what [my child is] watching, how to monitor, for smaller ages, [technology] is good for education, but so many bad effects [are also there]" (I3).* Another participant mentioned concern for online bullying and trolling and the need to provide students with counseling on these topics, *"we have to make sure the children are guided towards the right direction as they find it difficult to know what to avoid etc. online bullying and trolling are very dangerous" (I4).*

4.1.3 Expectations and Aspirations for the Future. One common aspiration of the participants was **incorporating technology within the school that is at par with schools in the US or European countries**, where there is understood to be better awareness regarding children with

special needs, and better integration within mainstream schools: *"In the US and European countries, they have a lot more awareness, the government, and then the education system, have subsides for autistic children, in the public school. But in India they don't train the teachers, [and there is] no integration with the normal school" (I1).* Technology in schools was appreciated by the parents as its usage was streamlined and monitored, *"schools should have technology because technology is monitored then. Kids are interested in technology. India should also be at par with the world in technology" (I3).* There was also a mention of **using mainstream technologies and following the latest trends**, for children with special needs, *"any existing technology that has been built for the mainstream lot, can also be used for special needs is what I actually learned, and am constantly learning" (I5).* Parents mentioned their child using technology on their own with a sense of pride, *"[my child] is quite techno savvy" (I1).*

One positive aspect of using technology at the special school was that even when the educator changes, the child is not uncomfortable, as the medium of intervention, the device, remains the same. This is especially beneficial for children with autism who maybe uncomfortable interacting with people they do not know. *"The minute you place the tablet in front of a child, the mediator is the tablet, to learn, so the focus goes from the educator to the tablet" (I5).*

From the students' perspectives, **being provided devices or access to games was a privilege or reward for good behavior**. Learning how to use technology and using technology, also made the students feel socially included. However, **not being allowed access to technology was consequently thought of as punishment**. *"Because some of the student are not trusted with the usage of technology, and are not being provide devices, and they feel inferior in the class as they sometimes showcase their skills through technology" (I4).* The participant further shared their **expectations from technology to be more inclusive in the near future by supporting mechanisms of non-verbal and non-textual communication**. *"Students [who] cannot write or type, so maybe technology can create a platform that does not require so much typing for communicating...so depending on their ability, they would be able to choose they way communicate" (I4).* Examples of students being empowered and enabled by technology were already visible at the school, with students learning how to transfer files using Bluetooth even if they could not really spell the word, *"some student, who do not know how to spell Bluetooth or spell the [name of] song, but they are able to recognize the steps in transferring a file over Bluetooth. So they are still learning regardless of what they know. They improve their communication and socialization aspects, to be included and feel appreciated" (I4).*

Given the positive experiences with technology at the school, there is an interest in adopting a technology-based curriculum for special education in the near future. To realize this vision, researchers at the school are already involved in creating such an IT-based curriculum themselves and making it available to other special schools across the country. Thus, there is a desire to see technology being incorporated across schools in the country. *"Two years from now, I hope there is more technology usage in the classrooms and schools, with tablets, online and offline videos etc. and that it would be common everywhere and not only elite schools. And with the Google for education free platform, this might happen" (I5).*

4.2 Finnish Parents' Perspectives towards Special Education and Technology

The Finnish stakeholders that were interviewed consisted of four parents of children with special needs. The responses to the interview framework were grouped into three main categories: current technology access and usage, the challenges faced towards current technology access and usage, and expectations for the future. Next, these responses are summarized and participant quotes are provided (F1–F4).

4.2.1 Current Technology Access and Usage. All participants mentioned that their daily use of technology was related to their work, and also **work was where they got information about the latest technology**. One participant mentioned that she also got information by following work-related Facebook groups. Work and other people were mentioned often, but also two participants mentioned that they read physically printed media, such as magazines or newspapers. *"Depends on technology. I work for a high-tech company...From the Internet, but also discussing with family members. Some-feeds and it's related to the work. Professional magazines and printed media" (F4).* **Female participants also mentioned getting information through a male member in their family**, *"if I would, I'd probably be looking for Google—or I would ask my husband. He's probably the first one" (F3).*

All participants mentioned using mobile phones, tablets, computers and internet at home and work. Computers were used mainly for work by parents, but **children used computers also for gaming**. All participants mentioned using popular applications and services, such as Facebook, YouTube, Google, WhatsApp, and for banking, online shopping and public transportation. However, the use for banking and online shopping was not on a daily basis. All participant were using Skype at work, and two mentioned that their use is very advanced, e.g. teaching online or daily meetings. *"Before, when I trained people and groups locally, so I had to reserve the facilities and the food. And now I do the same through Skype, from my own bedroom" (F2).*

Three participants mentioned that technology is used for world wide entertainment services such as Netflix and C More, and also Finnish entertainment services such as Ruutu+[10] and ElisaViihde[11]. One participant mentioned that the family uses smart home technology, to control home security and e.g. lighting using a mobile device. The access to control is restricted to only the parents. In the home environment in general, **technology was used quite widely but mainly for entertainment**. One participant even mentioned using technology actively for online workouts and exercising live, *"and then I exercise so that I have an Apple iPad, and a display in my own gym space" (F4).*

Educational technology is usually introduced through the teachers and therefore, the use of technologies is usually communicated to parents through Wilma[12]. Most of the schools in Finland use the Wilma system to help their home-school communication. One participant mentioned that they receive information at the student-parents' evening at the school. The use of education technology at school and home can vary. Three participants mentioned that their child has played Ekapeli[13], a child-friendly computer game developed to help learning to read (Figure 2 shows a screenshot of the game). *"Ekapeli was used in preschool. During the first class they got some other application where they have done some geography tasks" (F3).* All participant mentioned that their children use Bingel[14] at school, but it can also be used at home. Bingel is a widely used digital learning platform for primary education in Finland having game like features to encourage engagement to learning.

In the case of special education needs, **assistive technology such as alternative communication devices, are introduced through other actors, e.g. speech therapists**. One participant mentioned that the child uses GoTalk[15] for communication. *"We were introduced to the application through speech therapy. The speech therapist encouraged it because the child was found to be interested in technology. The child is enthusiastic about traditional technology such as VHS tapes and all of these.*

[10]https://www.ruutu.fi/plus
[11]https://elisaviihde.fi/
[12]https://www.visma.fi/inschool/en/
[13]https://info.grapholearn.com/
[14]https://www.sanomapro.fi/bingel/
[15]https://www.attainmentcompany.com/gotalk-now

However, it was noticed that the child needs pictorial support" (F2). If the technology is assistive and it is used for well-being, the need for technology is really concrete.

4.2.2 Challenges Towards Technology Access and Usage. As for technology in education, the participants mentioned that they are not completely aware of what technologies are used. All participant highlighted the fact that **teachers' knowledge of technology varies**. One explanatory factor was mentioned as the difference between generations, but the **additional training of teachers was also seen as very important. Parents expected teachers to guide them better**, *"there were no instructions given for using Bingel"(F2).* A lack of content was not mentioned as a challenge, but a quality of content was. Participants also mentioned that applications are less user-friendly. Support, for technology, seems to be received from peers.

Participants also mentioned that use of technology requires regular maintenance of hardware and software at school, but also at home. In this context, also the **social and economic inequality of children was mentioned**. *"I see an increase in inequality all the time" (F2).* In the future this will be seen as a problem, if children are required to have their own personal devices at school. One participant stated that, *"I don't believe that society can pay for all the smart devices of children" (F3).* However, the participants mentioned that software and devices are reasonably priced for their current income levels. *"Everyone should be offered support equally, but I do not see a problem with the purchase of technology, for my children" (F2).*

In general, one of the biggest concerns was that **technology is changing rapidly**, *"technology is moving fast, so it's hard to master" (F2).* Almost all the participants mentioned that not only is technology rapidly changing, but that change is so fast that most of people can not even recognize the changes and what they mean, for example, concerning privacy issues. One participant mentioned that *"it's a security issue in the sense that you need to log-in everywhere. And then there are these privacy regulations, directives, and other legislative acts that everybody should know. It's just crazy. No one understand what those mean. There should be more open discussion about these" (F2).*

Participants were especially **concerned about child safety online and they mentioned challenges towards monitoring and supervising a child's use of technology**. All participants mentioned that they feel that it's important to discuss with children about online content. One participant expressed, *"I think that I am the one who limits our children's content. But I'm trying to keep it very simple. What I say is that this is the age limit. It can be really tricky because they can say that their friends or older children can play. But then again, anyway younger children prefer to play Roblox*[16]*, which is not the kind of Fortnite*[17]*" (F4).* **Technology addiction was also mentioned as a very big concern**. Participants mentioned that although they would prefer that their child use technology for not more than 1–2 hours per day, they acknowledge that current use is probably much longer. Two participant mentioned that if they let children spend as much time online as they want, the children would do it. One participant even shared experiences on restricting use, *"if I take the smartphone from my child, then the child will rage. But after one day the child is as sweet as usual" (F2).* Participants also raised the fact that technology does create creates a lot of opportunities for those using assisted technology.

4.2.3 Expectations and Aspirations for the Future. Almost all the participants mentioned that technology is rapidly changing, but they do not feel that it changes things in basic education over the next two years. *"I do not think that technology will radically change things in basic education over the next two years, because there are curricula. But resources and money are also influencing [this]" (F3).* All participant saw that **technology helps and motivates their children in their**

[16] https://www.roblox.com/
[17] https://www.epicgames.com/fortnite/

learning process. *"He is social and probably learning is going to be OK. You can't listen to that speech and teach it to the technology, but it doesn't interest technology, so it strengthens the motivation. Those exercises in the Bingel have helped of course" (F2).*

Social relationships and remembering the human behind the technology, were considered important. For instance, one participant was **wary of technology's affects on social relationships**, *"I don't want technology to replace relationships, except in situations where it is essential or brings other values. Things that make life easier should be there without disturbing social relationships" (F4).* Further, they expressed concern on the human aspects of technology design, *"I hope that technology will continue to help us and make things easier, but it should never forget that person behind. It will be the most important, including the people's thoughts" (F4).* Participants also stated that the model of technology use comes from home. Participants commented that technological progress is inevitable, **and Finland should not lag behind**. *"I think how children use and understand technology also comes from home. Technology can't be prevented. The world would be stuck and Finland would lag behind the rest of the world" (F3).* Participants also mentioned a growing social and economic inequality among communities, highlighting that the availability of technology affects people regardless of where they live. Further, **parents were aware of the changing landscape of technology for their children and how future workers will be impacted**. *"But it is the way of communication, that is different. So, our children will definitely use quite different technology that we can even imagine now. The work of our children will probably be very different. Maybe something in the virtual spaces, I don't know" (F4).*

4.3 Summary of Findings

Overall, Indian and Finnish interview responses brought out several common themes. A challenge that resonated with all the participants in both countries was **monitoring and supervising a child's technology use and providing a safe online environment**. This was somewhat expected, with several also commenting on the ill effects of technology, such as, addiction, online bullying, access to unsuitable content and crimes against children. Indian participants mentioned that **increasing use of technology at home was affecting the child's physical activity and opportunities for socialization**. **At home use, technology in both locations was mentioned to be mostly for games and entertainment**. However, participants also mentioned that the **requirement to monitor or supervise technology depends largely on how it is used**.

Given the wide array of differences in the two locations, including but not limited to culture, resources, diagnostic processes, and private versus public schooling—unsurprisingly there were also differing perspectives towards technology access, adoption, and expectations. From a socio-technical aspiration perspective, **Indian stakeholders were keen to adopt newer technology** in schools and at home to be par with the developed world. However this may be explained by the school being a private service that they pay-for for their child versus a service provided by the government in Finland. For Finnish participants, cost was not a deterrent towards access to technology as much **concern on the lack of relevant or engaging content**, included a realization of how **learning or educational content may never be as engaging and engrossing as online games**. Indian participants mentioned costs as one of the challenges towards access to technology, and attributed a challenge towards **a lack of information on how to access content relevant for a special needs child's learning**, but not a lack of content per say. Finnish participants acknowledged that **teachers should get more support to introduce technology into their classrooms**. There was also a mention of the **school specialists and parents working together to be better informed on available applications**.

Almost all **Indian participants mentioned social isolation as one of the biggest challenges towards technology adoption**. Social isolation was not mentioned as a concern by the

Finnish participants, although one participant mentioned a fear of social relationships being replaced by technology. **Finnish participants mentioned being overwhelmed by the fast pace of technological development**, but one Finnish participant also mentioned a fear of lagging behind from the result of the world, if they chose to stay stuck. The Finnish participants also desired improvement in existing learning applications to be as engaging and engrossing as games, rather than having new applications.

5 DISCUSSION

In this work, we focused on understanding stakeholder perspectives towards current technology use for education for children with special needs. We explored two different locations and contexts, one in India and one in Finland. From our previous work [40], we proposed a fourth dimension, of socio-technical aspirations, to Boujarwah et al.'s framework for assistive technology design. Several studies already support the need to understand users' technology aspirations for sustainable outcomes, especially within resource constraint environments and for HCI for development [3, 31, 47]. Socio-technical aspirations also become important when considering acceptance and adoption of mainstream technology for supporting day-to-day activities for children with special needs. Moreover, children with special needs tend to display nonlinear progress, when compared with their typically developed peers, which requires stronger motivation from parents and therapists to stay on course with planned interventions [2]. Thus, community driven socio-technical aspirations of the stakeholders involved in raising children with special needs can provide that motivation. In this section, we first build a case for studying socio-technical aspirations within the context of special needs, discuss our main findings with respect to socio-technical aspirations, then map the findings to Bourjarwah et al.'s framework [6], and lastly discuss the limitations of this work.

5.1 The Common Ground for Socio-technical Aspirations

Despite the differences in the socio-cultural, technological, and political contexts, along others, of the two locations, for instance when, compared with Hofstede's dimensions [19] and the World Value Survey [23]; there are still experiences and aspirations within the context of special needs that support the dimension of socio-technical aspirations. It can be said that the socioeconomic status of the participants—in terms of occupation, education, and income—was somewhat similar in both countries. Participants can be said to be a part of *urban middle-class*, with relatively good access to information and technology—also in the context of special education. *As such, they still do not represent the entire population of stakeholders, neither in India nor in Finland.* However, the challenges faced by the parents seem to be similar in both countries. These include *parents' overall expectation from and hope for teachers, even with varying levels of parent-teacher interactions; the desire for quality content that is engaging; the progress of technology, in general, being too fast to catch up to; and the challenges towards the supervision and monitoring of children's technology usage.* Parents in both countries expected the educators to be responsible for introducing technology in the classroom. Additionally, in India, parents expected guidance by educators for technology usage also at home. Parents in Finland mentioned how they would like teachers to be better supported for technology-based activities. Also the therapist and researchers in India mentioned the need for better support. However, in both cases, it was not evident who would offer that support. One of the Indian researchers also mentioned a lack of formal educational requirements for special education teachers. This complicated relationship between parents and special educators or therapist was also witnessed by Boujarwah et al. in their work with children with autism in Pakistan [8]. When designing and validating an application for identifying and assessing problematic behaviors at home in children with autism, Boujarwah et al. [8] found that a lack of communication between the parents and behavioral therapist could result in low levels of trust—where each side was not sure

if they experiences or instructions were understood. The different stakeholders that are involved in raising a child with special needs may have conflicting opinions on responsibilities towards technology usage, however, more research is required to understand this further.

Another common desire was access to quality content. In Finland, several *parents commented on the level of engagement and immersion of games, and how learning or educational content may never be as engaging and engrossing as online games, and may never win children's sustained attention and interest.* To us, *this relates to the parent's socio-technical aspirations to have engaging and immersive professional game-like application also in the educational context for their children.* This can be a direct outcome of a successful Finnish gaming industry[18]. Meanwhile, participants in India derive their the socio-technical aspiration from countries they considered more advance than them. *This desire for edutainment and the universal appeal of entertainment, unites the participants.* Finnish participants mentioned that their child has played Ekapeli, and according Ronimus et al. [37] a game-based intervention using Ekapeli can be effective in supporting children who have moderate or severe reading difficulties. Patel et al. [32] studied the effectiveness of a game-based reading intervention in India using GraphoLearn, an English adaptation of Ekapeli, and found that the application has potential learning benefits. According to McTigue et al. [27], the effect of technology on classroom learning has also challenges towards *attention to learning theories, methodological selection, and context for learning*. Further, *monitoring and supervising a child's technology use and providing a safe online environment* was mentioned in both countries. Parents mentioned struggling with regulating or limiting their child's technology use, especially at home. Parents in India appreciated that technology use in school was monitored and supervised. Parents in both countries mentioned a need for better supervision and monitoring tools and support for their child's online activities. Participants in both countries mentioned the fast pace of technological development, but also that today's children are more tech-savvy. Overall, all stakeholders mentioned some level of aspiration from technology and its use for children with special needs.

5.2 Unpacking the Dimension of Socio-technical Aspirations

Similar to Boujarwah et al.'s work [6], we identified contextual aspects that determine socio-technical aspirations using a reflexive thematic analysis—*the level of inclusiveness within a school*, *the level of support provided by parents and teachers towards a child's own aspirations towards learning and entertainment*, and *parents' and teachers' own previous experiences with technology*. Many times, the terms integrated and inclusive are used interchangeably within the context of schools and education. However, an integrated school does not imply inclusiveness, that is, children with special needs learning together or in collaboration with their typically developed peers the same material and in the same classroom. This again leads us towards the difference between an educational policy as defined by a government and the end users' experience of it [45, 46]. From the end users' perspective, inclusion—at school, at home, and within society in general, is key. By being excluded from mainstream private or public schooling in India, children have less opportunities for social inclusion with their typically developed peers, and also as compared with their Finnish counterparts. We speculate that parents and teachers' expectations and concerns considering technology for children with special needs can also depend on the type of schools the child has access to, but further research is required to understand such comparisons better. Boujarwah et al.'s [6] dimension of socio-tech infrastructure supports this relation between expectations and access, and in this work we aim to extend this focus to the desires and aspirations of the different stakeholders towards what they would want from their schools or communities, in addition to what is currently available.

[18]https://www.helsinkitimes.fi/207-themes/player-one/16289-finland-still-a-gaming-superpower-in-2018.html

Article 12 of the United Nations Convention on the Rights of a Child, states that children have a right to participate in making decisions that affect them, and that their opinions be "given due weight in accordance with the age and maturity of the child" [48]. This is applicable also to children with one or more disabilities, as stated in Article 23 [48]. In our work, Finnish participants mentioned that having educational applications be as engaging as popular commercial video games might be more productive than having newer applications. They seemed receptive to their child's desire to play video games. Another participant mentioned that their child enjoyed watching specific types of videos online that might be considered "weird", but they were comfortable with it. Further, from an Indian perspective, using mainstream technology provided social acceptance to children with special needs and way to be socially included [40]. Since we did not interview the children directly, capturing their aspirations was limited, we did still identify that other stakeholders take children's aspirations into account when discussing aspirations towards educational technology. Moreover, children's aspirations can be formed through several factors, from mainstream media, from their peers, or then individually that might be different than the former two. It is important to consider children as stakeholder in their own education, which was missing in our previous work and also Boujarwah et al. framework [6], thus it is highlighted in this paper. However, further research is required to understand this in more detail.

It is well known that previous technology experience of an individual affects their perception of and attitude towards technology, which in turn directly affects their acceptance of it [49]. We can further extrapolate that previous experience of the various stakeholders involved in raising a child with special needs, affects their perception and attitude towards technology also for their children. For instance, in the Indian context, where the technology landscape is still developing, participants were hopeful of using more technology within the school and having a more reliable data connection. Meanwhile in Finland, participants mentioned a sense of being overwhelmed with the fast pace of technological progress, especially within the context of monitoring or supervising their child's use of technology, even though they consumed it daily for work, being social, and for entertainment. In Boujarwah et al.'s framework [6], variation in technology access, and thus experience, across cultures is captured in their socio-technical infrastructure dimension as a component of technology and civic infrastructure. We note here that previous technology experience of an individual can vary widely even within the same cultural, socio-economical, educational, and geographical backgrounds. However, aspirations towards technology ownership or experience can still exist despite not being met with the current infrastructure. Moreover, the technology landscape itself is evolving rapidly, and therefore stakeholder expectations transcending current infrastructural support is a transient phase, captured by the dimension of socio-technical aspirations. Previous work in Pakistan by Boujarwah et al. [8] mentions the importance of considering grandparents' technological experiences and expertise when designing an application for in-home behavior assessment of children with autism, as it is common for inter-generational cohabiting family members, in Pakistan and many other Asian countries, to share the responsibilities in raising a child with special needs. Thus, there can be different levels of technology experience, expertise, and subsequently aspirations, within the same household.

Understanding socio-technical aspirations of various stakeholders is important to design sustainable technology [47], and this thinking can be extended to designing sustainable assistive technologies or for long-term adaptation of mainstream technologies in a special education context. For instance, in India there was a social status and value attached to owning and using technology and a desire to be at par with schools in the west, assumed to be better. In Finland, parents wanted educational applications to be as engaging as popular commercial video games, such as Fortnite. In recent years there has been a conscious shift in design paradigms: from designing for user needs, for that model unknowingly projects designers' or researchers' needs on to their users, to

designing for user aspirations. The aim is to "shift the attention from problem solving to people nurturing", which can lay the groundwork for positive social change [47]. Moreover, within assistive technology design, there is an understanding that technology designed solely for a subset of users, can potentially make them self-conscious, highlight a particular disability even further, and further isolate an individual [42]. This again brings into focus the dimension of socio-technical aspirations both from the perspective of assistive technology design and for mainstream technology adoption.

5.3 Relating Our Findings to Boujarwah et al.'s Framework

Boujarwah et al. [6] defined a three-part framework to situate the design of assistive technology within the context of culture; lifestyle, socio-technical infrastructure, and monetary and informational resources. The dimension of **lifestyle** incorporates the day to day social experience of a child with special needs the various stakeholders involved in raising them, that is, family structure, linguistic environment, and religious beliefs. For instance, Boujarwah et al. [8] discuss the importance of designing applications that can be used by grandparents of children with autism since they can sometimes be the primary caregivers or step in for one frequently. Thus, in the generally more collectivist Asian societies as compared with Nordic societies, communities are close knit with extended family and relatives playing a large role in the decision making for a child. In our study, Indian participants were disturbed by the possibility of social exclusion through the use of technology. They also hoped that future technologies will reduce the reliance on textual and verbal communication, becoming inclusive to a larger cohort of children with special needs. This sentiment was also shared by one participant in the Finnish group, who mentioned not wanting technology to replace *physical* social relationships. Further, in both locations technology addiction was a cause for concern; male family, or work, members introduced technology to others and also helped in resolving issues; and technology was used for games and entertainment by children at home, rather than for educational or learning purposes, which was frowned upon by the specialist at the special school in India.

Socio-technical infrastructure relates to both civic infrastructure and services available to children with special needs and the different stakeholder involved in raising them. Socio-technical aspirations differ from socio-technical infrastructure, in that, designing for current technology access and infrastructure misses the opportunities driven by the ambitions and desires of the people involved. These desires may or may not be a direct result of access, and can arise in spite of underdeveloped infrastructure and lack of access. The educational system in India suffers from a lack of integration of special education with mainstreaming schooling. Therefore, it is common for parents to pay for private special education schools and sessions. With special education as a paid service, quite possibly an urban *luxury*, the parents and researchers expected and hoped for better professional education, training, and technical support. On the other hand, the researchers also mentioned an expectation from the parents to be the *first level educators*, or advocates, for their child. Further, the parents seemed to be quite involved in the educational interventions received by their child at the special school. Technology-training of teachers was deemed important also by participants in Finland. In both locations, parents expected educators to play an active role in the child's educational and technology experiences.

Another aspect of socio-technical infrastructure is the financial challenge in the level of inclusiveness supported at the school level. In Finland, where schools are integrated, even though they provide more opportunities for social inclusion from an administrative perspective, there might be limited funds available for children with special needs as they compete with overall school activities also for typically developed peers. But in the case of India, having a private special school already ascertains that all funds are directed towards interventions for children with special needs.

Monetary and informational resources available to a community has a direct affect on its technology access and usage, such that, there can be a "polarization of educational opportunities" in countries with large financial disparities [6]. Surprisingly, a Finnish parent mentioned their apprehension of a possibly growing disparity among different socio-economic classes and how that would affect technology access at home and in schools. In additional to access to monetary, and thus, educational resources, in India, there was an additional concern towards rampant misinformation and misguidance, especially for non-urban parents, regarding the needs of a child with special needs. It was suggested that this could be countered by parents actively seeking information online. A lack of information on online content suitable for children with special needs was mentioned as a concern by several Indian participants in our study, even in a private special school setting. This implies that access to monetary resources, as in the case of the Indian participants, does not equate to access to better informational resources [18].

Educational technology, in both locations, was mostly introduced at the school, including a specific assistive application that was introduced by a speech therapist in Finland. Similarly, parents across the two locations were unified in their expectations from the schools and teachers implying that the burden of technology innovation, introduction, adoption, and sustenance lies within the school and its staff. In India, there was also an expectation that teachers, and the schools, would also guide the parents for technology interventions at home. It was noted that currently teachers' technical knowledge and skills vary greatly, due to generational differences in Finland and a lack of (till 2014) a quality degree program in special education in India. All participants also mentioned a challenge in monitoring and supervising online activities of their child, and a lack of information, or a responsible entity, for ensuring online child safety.

Many of our findings relate to the stakeholders' **socio-technical aspirations** towards the future of technology for their child. One common aspiration in both locations was to stay at par with the rapid global technological progress, with participants in India mentioning their desire to have a special education system, and use mainstream technologies that are par with the West, and a Finnish participant not wanting to be left behind. Further, Indian participants expressed their desire for a technology-based educational curriculum available to all schools and not only the elite. This desire to adopt novel and innovative technology, now and in the future, is the *essence* of the dimension of *socio-technical aspiration*. By proposing socio-technical aspirations to be its own dimension, we bring focus on designing for the future and for long-term stakeholder goals. The gap between socio-technical infrastructure and aspirations needs more attention since, as uncovered in our study, tech-capable communities can be overwhelmed with the quantity and underwhelmed with the quality, while tech-aspiring communities only hope to emulate the "west". Going forward, socio-technical aspirations, can also capture desires to use novel technologies and interactions, as they become more popular in mainstream media.

5.4 Limitation of the Work and Next Steps

Limitations of this work include the small number of participants that were interviewed, with five in India and four in Finland, and the variations between them. From their role in raising a children with special needs, with parents, researchers, and an occupation therapist in India and to only parents in Finland. To the Indian stakeholders being involved in raising a child with autism, and Finnish parents having a child participating in an after school rehabilitation program for children with ADHD. Although the interview framework was the same for all participants, another limitation is the variation in the Indian and Finnish special education context. As mentioned earlier, Tamana is a private non-profit special school in New Delhi that caters to students from varying socio-economic backgrounds. The interviews were conducted at one of its school, meant specifically for children with medium-low functioning autism, where parents or caregivers usually accompany

their child to school. Therefore, the participants interviewed in India are quite involved in their child's day to day educational needs. Thus, in addition to the variations in the two cohorts there are differences between modes of education—private versus public schooling, and the varying abilities of the children—from medium-low functioning children with autism to those without yet a formal diagnosis (mainly due to a difference in receiving a formal diagnosis).

Given these limitations, this work provides only a snapshot into the socio-cultural experience of children with special needs from an Indian and Finish perspective. However, this work still serves as a starting point to build our understanding of socio-technical aspirations among different stakeholders, contexts, and locations. For instance, almost all of the participants, in both countries, focused on mainstream technology use for their child with only one parent explicitly mentioning the use of an assistive device for everyday communication. There might be differences in the way an assistive device is perceived when compared with a mainstream one, which is also not captured in the current study. Moreover, the interviews in India were conducted by a researcher working with Tamana since Oct 2013, which created trust among the interviewer and interviewee. In Finland, the researchers and parents had not met before, although they were introduced through a credible source.

Going forward, our plan is to overcome the limitations mentioned above by conducting further interviews in both countries with comparable demographics, including children using assistive technology in their everyday use and their parents, special educators working in public and private schools, and school's administrative staff. This enables us to further explore the differences between assistive and mainstream technology use for special education and technology use in public and private schooling, and therefore identify implications for assistive technology design when incorporating socio-technical aspirations of the various stakeholders.

6 CONCLUSION

The perceptions, expectations, and assistance towards children with special needs is rooted in the socio-cultural makeup of the community. Previous work defines a three-part cultural framework for assistive or adaptive technology design consisting of lifestyle, socio-technical infrastructure, and monetary and informational resources. Based on our work with a special school in New Delhi, we proposed a fourth dimension to this framework—of socio-technical aspirations. We define socio-technical aspirations as *the individual or community driven ambition and desire to own or use a specific technology for either personal benefit or societal acceptance, or both.* By determining stakeholder's socio-technical aspirations in a given context, researchers and designer can better ascertain the motivations towards technology acceptance and adoption. This in turn can potentially affect the sustainability of the technology being designed.

To further understand the dimension of socio-technical aspirations, we replicated a part of our Indian study in Finland. Analyzing the findings from interviews with the various stakeholders in India and Finland, who work with or are a parent to a child with special needs; we identified different attributes that can contribute to socio-technical aspirations in a given context. This includes, but is not limited to, the level of inclusiveness supported in the school; the support for child's own aspirations, and how they are heard and met by parents and teachers; and previous technology experience of the various stakeholders involved in raising a child with special needs, which can determine their attitude towards technology for themselves and their child. Overall, identifying socio-technical aspirations of the various stakeholders can potentially influence the adoption and sustainability of the technology being designed.

ACKNOWLEDGMENTS

We are grateful to all the people who participated in our study.

REFERENCES

[1] Act 628/1998. 1998. Perusopetuslaki (Basic Education Act). Retrieved 23rd April 2019 from http://www.finlex.fi/fi/laki/ajantasa/1998/19980628

[2] Krishnaveni Achray. 2009. *Autistic Children in India: An Insight.* Ph.D. Dissertation. University of Delhi, India.

[3] Payal Arora and Nimmi Rangaswamy. 2014. ICTs for leisure in development: a case for motivation, exploration, and play in the global South. *Information Technologies & International Development* 10, 3 (2014), v–v.

[4] American Psychiatric Association et al. 2013. *Diagnostic and statistical manual of mental disorders (DSM-5®).* American Psychiatric Association Publishing, Washing DC, USA.

[5] Fatima Boujarwah, Gregory Abowd, and Rosa Arriaga. 2012. Socially computed scripts to support social problem solving skills. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* ACM, ACM, New York, NY, USA, 1987–1996.

[6] Fatima A Boujarwah, Hwajung Hong, Gregory D Abowd, Rosa I Arriaga, et al. 2011. Towards a framework to situate assistive technology design in the context of culture. In *proceedings of the 13th international ACM SIGACCESS conference on Computers and accessibility.* ACM Press, New York, New York, USA, 19–26.

[7] Fatima A Boujarwah, Mark O Riedl, Gregory D Abowd, and Rosa I Arriaga. 2011. REACT: intelligent authoring of social skills instructional modules for adolescents with high-functioning Autism. *ACM SIGACCESS Accessibility and Computing* 99 (2011), 13–23.

[8] Fatima A Boujarwah, Agata Rozga, Gregory D Abowd, Rosa I Arriaga, Ron Oberleitner, Suhas Pharkute, et al. 2012. Towards in-home collection of behavior specimens: Within the cultural context of autism in Pakistan. In *2012 6th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth) and Workshops.* IEEE, 9–16.

[9] Clarke V. Braun, V. and G. Terry. 2018. *Handbook of Research Methods in Health Social Sciences.* Springer nature Singapore Pte Ltd., 152 Beach Road, 21-04 Gateway East, Singapore 189721.

[10] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative research in psychology* 3, 2 (2006), 77–101.

[11] Eric Brewer, Michael Demmer, Melissa Ho, RJ Honicky, Joyojeet Pal, Madelaine Plauche, and Sonesh Surana. 2006. The challenges of technology research for developing regions. *IEEE Pervasive Computing* 5, 2 (2006), 15–23.

[12] Tamara C Daley. 2004. From symptom recognition to diagnosis: Children with autism in urban India. *Social science & medicine* 58, 7 (2004), 1323–1335.

[13] Miraj U Desai, Gauri Divan, Frederick J Wertz, and Vikram Patel. 2012. The discovery of autism: Indian parentsâĂŹ experiences of caring for their child with an autism spectrum disorder. *Transcultural psychiatry* 49, 3-4 (2012), 613–637.

[14] Statistics Finland. 2017. Official Statistics of Finland (OSF): Special education. Retrieved 23rd April 2019 from http://www.stat.fi/til/erop/2017/erop_2017_2018-06-11_en.pdf

[15] Finnish National Agency for Education. 2018. Teachers and principals in Finland. Retrieved 18th April 2019 from https://www.oph.fi/download/195430_Teachers_and_principals_in_Finland.pdf

[16] Rosemary Garris, Robert Ahlers, and James E. Driskell. 2002. Games, Motivation, and Learning: A Research and Practice Model. *Simulation & Gaming* 33, 4 (dec 2002), 441–467. https://doi.org/10.1177/1046878102238607

[17] Roy Richard Grinker. 2008. *Unstrange minds: Remapping the world of autism.* Basic Books, New York, United States.

[18] Nakull Gupta and Rosa I Arriaga. 2014. Tell Me About Autism: Autism Resources for India. In *Proceedings of the Fifth ACM Symposium on Computing for Development.* ACM, New York, New York, USA, 123–124.

[19] Geert Hofstede. 2011. Dimensionalizing cultures: The Hofstede model in context. *Online readings in psychology and culture* 2, 1 (2011), 8.

[20] Hwajung Hong, Gregory D Abowd, and Rosa I Arriaga. 2015. Towards designing social question-and-answer systems for behavioral support of individuals with autism. In *2015 9th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth).* IEEE, 17–24.

[21] Hwajung Hong, Jennifer G. Kim, Gregory D. Abowd, and Rosa I. Arriaga. 2012. Designing a Social Network to Support the Independence of Young Adults with Autism. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work (CSCW '12).* ACM, New York, NY, USA, 627–636. https://doi.org/10.1145/2145204.2145300

[22] Hwajung Hong, Jennifer G Kim, Gregory D Abowd, and Rosa I Arriaga. 2012. SocialMirror: motivating young adults with autism to practice life skills in a social world. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work Companion.* ACM, 41–42.

[23] Ronald Inglehart. 2006. Mapping global values. *Comparative sociology* 5, 2-3 (2006), 115–136.

[24] Lilly Irani, Janet Vertesi, Paul Dourish, Kavita Philip, and Rebecca E Grinter. 2010. Postcolonial computing: a lens on design and development. In *proceedings of the SIGCHI conference on human factors in computing systems.* ACM Press, New York, New York, USA, 1311–1320.

[25] Eija Kärnä, Kaisa Pihlainen, Erkki Sutinen, and Marjo Virnes. 2007. Technology in Finnish special education - Toward inclusion and harmonized school days. *Informatics in Education* 6, 1 (2007), 103–114.

[26] Catherine Lord, Susan Risi, Linda Lambrecht, Edwin H Cook, Bennett L Leventhal, Pamela C DiLavore, Andrew Pickles, and Michael Rutter. 2000. The Autism Diagnostic Observation ScheduleâĂŤGeneric: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of autism and developmental disorders* 30, 3 (2000), 205–223.

[27] Erin M. McTigue, Oddny Judith Solheim, Wendi K. Zimmer, and Per Henning Uppstad. 2019. Critically Reviewing GraphoGame Across the World: Recommendations and Cautions for Research and Implementation of Computer-Assisted Instruction for Word-Reading Acquisition. *Reading Research Quarterly* (may 2019), rrq.256. https://doi.org/10.1002/rrq.256

[28] Fnu Nazneen, Fatima A Boujarwah, Shone Sadler, Amha Mogus, Gregory D Abowd, and Rosa I Arriaga. 2010. Understanding the challenges and opportunities for richer descriptions of stereotypical behaviors of children with ASD: a concept exploration and validation. In *Proceedings of the 12th international ACM SIGACCESS conference on Computers and accessibility*. ACM, ACM, New York, NY, USA, 67–74.

[29] Finnish Ministry of Education and Culture. 2017. Finnish education in a nutshell. Retrieved 18th April 2019 from https://www.oph.fi/en/statistics-and-publications/publications/finnish-education-nutshell

[30] National University of Educational Planning, Administration, Department of School Education, and Government of India Literacy, Ministry of Human Resource Development. 2016. School Education in India. Retrieved 24th April 2019 from http://udise.in/Downloads/Publications/Documents/U-DISE-SchoolEducationInIndia-2015-16.pdf

[31] Kala Parasuram. 2006. Variables that affect teachersâĂŹ attitudes towards disability and inclusive education in Mumbai, India. *Disability & Society* 21, 3 (2006), 231–242.

[32] Priyanka Patel, Minna Torppa, Mikko Aro, Ulla Richardson, and Heikki Lyytinen. 2018. GraphoLearn India: The Effectiveness of a Computer-Assisted Reading Intervention in Supporting Struggling Readers of English. *Frontiers in Psychology* 9 (jun 2018), 1045. https://doi.org/10.3389/fpsyg.2018.01045

[33] Henri Pesonen, Tiina Itkonen, Markku Jahnukainen, Elina Kontu, Tiina Kokko, Terhi Ojala, and Raija Pirttimaa. 2015. The Implementation of New Special Education Legislation in Finland. *Educational Policy* 29, 1 (jan 2015), 162–178. https://doi.org/10.1177/0895904814556754

[34] Fanny Pettersson. 2018. On the issues of digital competence in educational contexts – a review of literature. *Education and Information Technologies* 23, 3 (01 May 2018), 1005–1021. https://doi.org/10.1007/s10639-017-9649-3

[35] Jonna Pulkkinen and Markku Jahnukainen. 2016. Finnish reform of the funding and provision of special education: the views of principals and municipal education administrators. *Educational Review* 68, 2 (2016), 171–188. https://doi.org/10.1080/00131911.2015.1060586

[36] Mark Riedl, Rosa Arriaga, Fatima Boujarwah, Hwajung Hong, Jackie Isbell, and Juane Heflin. 2009. Graphical social scenarios: Toward intervention and authoring for adolescents with high functioning autism. In *2009 AAAI Fall Symposium Series*.

[37] Miia Ronimus, Kenneth Eklund, Laura Pesu, and Heikki Lyytinen. 2019. Supporting struggling readers with digital game-based learning. *Educational Technology Research and Development* 67, 3 (jun 2019), 639–663. https://doi.org/10.1007/s11423-019-09658-3

[38] Eric Schopler, Robert J Reichler, Robert F DeVellis, and Kenneth Daly. 1980. Toward objective classification of childhood autism: Childhood Autism Rating Scale (CARS). *Journal of autism and developmental disorders* 10, 1 (1980), 91–103.

[39] Sumita Sharma. 2018. *Collaborative Educational Applications for Underserved Children: Experiences from India*. Ph.D. Dissertation. University of Tampere, Finland. https://tampub.uta.fi/handle/10024/104342

[40] Sumita Sharma, Krishnaveni Achary, Harmeet Kaur, Juhani Linna, Markku Turunen, Blessin Varkey, Jaakko Hakulinen, and Sanidhya Daeeyya. 2018. 'Wow! You're Wearing a Fitbit, You're a Young Boy Now!: Socio-Technical Aspirations for Children with Autism in India. In *proceedings of the 20th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM Press, New York, New York, USA, 174–184.

[41] Sumita Sharma, Saurabh Srivastava, Krishnaveni Achary, Blessin Varkey, Tomi Heimonen, Jaakko Hakulinen, Markku Turunen, and Nitendra Rajput. 2016. Gesture-based interaction for individuals with developmental disabilities in India. In *Proceedings of the 18th International ACM SIGACCESS Conference on Computers and Accessibility*. ACM Press, New York, New York, USA, 61–70.

[42] Kristen Shinohara and Jacob O Wobbrock. 2011. In the shadow of misperception: assistive technology use and social interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM Press, New York, New York, USA, 705–714.

[43] Nidhi Singal. 2009. Education of children with disabilities in India, Paper commissioned for the EFA Global Monitoring Report 2010, Reaching the marginalized. Retrieved 24th April 2019 from https://unesdoc.unesco.org/ark:/48223/pf0000186611

[44] Social and Rural Research institute. 2014. National Sample Survey of Estimation of Out-of-School Children in the Age 6-13 in India. Retrieved 24th April 2019 from https://mhrd.gov.in/sites/upload_files/mhrd/files/upload_document/National-Survey-Estimation-School-Children-Draft-Report.pdf

[45] Shruti Taneja Johansson. 2014. A critical and contextual approach to inclusive education: Perspectives from an Indian context. *International Journal of Inclusive Education* 18, 12 (2014), 1219–1236.

[46] Shruti Taneja Johansson. 2014. âĂIJHe Is Intelligent but DifferentâĂİ: StakeholdersâĂŹ Perspectives on Children on the Autism Spectrum in an Urban Indian School Context. *International Journal of Disability, Development and Education* 61, 4 (2014), 416–433.

[47] Kentaro Toyama. 2017. Design, needs, and aspirations in international development. In *International Conference on Social Implications of Computers in Developing Countries*. Springer, New York, 24–32.

[48] UNICEF. 1990. The United Nations Convention on the Rights of the Child. Retrieved 24th April 2019 from https://downloads.unicef.org.uk/wp-content/uploads/2010/05/UNCRC_united_nations_convention_on_the_rights_of_the_child.pdf?_ga=2.214728407.1110747670.1556526254-142543787.1556526254

[49] Viswanath Venkatesh and Fred D Davis. 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science* 46, 2 (2000), 186–204.

[50] Marjo Virnes. 2008. Robotics in special needs education. In *Proceedings of the 7th international conference on Interaction design and children - IDC '08*. ACM Press, New York, New York, USA, 29–32. https://doi.org/10.1145/1463689.1463710

[51] Katee Wallis and Jennifer Pinto-Martin. 2008. The challenge of screening for autism spectrum disorder in a culturally diverse society. *Acta Paediatrica* 97, 5 (2008), 539–540.