Virtual Collaboration Tools for Mixed-Ability Workspaces: A Cross Disability Solidarity Case from Turkey

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ABSTRACT

A growing body of literature on mixed-ability teams within HCI investigates how disabled and non-disabled people collaborate. Still, how different disabilities can interact in a mixed-ability team is underexplored, especially for long commitments and in non-western contexts. As an emerging perspective in accessibility studies in HCI, disability justice emphasizes the importance of cross-disability collaborations. Collaborative access, interdependence, and cross-disability dialogue are keys to building accessible mixed-ability interactions. We conducted ten in-depth interviews with the members of a unique mixed-ability team (which includes people with different physical disabilities) using the same workspace with cross-disability interactions in Turkey. We aim to understand the requirements for an accessible mixed-ability virtual workspace and to identify practical design considerations for cross-disability solidarity-oriented virtual collaboration tools. To ensure equal access in virtual workspaces, we suggest implications for centering collective access, balancing external power dynamics, and supporting language and cultural diversities.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in accessibility**.

KEYWORDS

Collaborative accessibility; Cross-Disability Solidarity; Disability justice; Mixed-Ability Teams

1 INTRODUCTION

Disability justice is an emerging perspective around accessibility studies in HCI that provides a framework for working towards equity and justice-oriented designs. In a recent CHI workshop named Dreaming Disability Justice, scholars criticized existing assistive technology research in HCI which may not always attend to the complex lived experiences of disabled people [39]. In line with this, accessibility research and research with the disabled community also started to use disability justice as a frame, thanks to many pioneering studies on this subject [3, 39]. Through different principles, disability justice emphasizes creating collaborative access through continuous social interactions, interdependence, and collaborative efforts of mixed-ability people [23]. Disability justice-oriented HCI work collectively highlights the importance of understanding and designing new systems to facilitate collaboration for mixed-ability people [13].

A growing literature in HCI on mixed-ability collaboration specifically focuses on workspaces and interactions of coworkers [7, 9, 25], with an increasing interest in virtual collaboration [14, 26, 27, 40], considering the requirements of the Covid-19 pandemic. Some of these studies provide practical implications for collaboration tools and platforms to become more accessible through presenting opportunities for interaction, customization, and flexibility [7, 14, 27, 40], for various and sometimes conflicting access needs of the collaborators [14, 27]. Covering different work contexts, occupations, and disabilities (e.g., blind and sighted coworkers [7, 11, 13], deaf and hearing coworkers [25, 43] or neurotypical coworkers and coworkers with disabilities [9, 14]), existing literature does a great job in terms of revealing the needs of diverse disabilities and how collaborative platforms may respond to these. However, significantly fewer studies explore how disabled and non-disabled people with various accommodation needs interact in a remote work environment [27].

In this study, we focus on the collaboration of different disabilities, especially in mixed-ability settings, as inspired by the recent disability justice debates [23]. Mixed-ability teams must not only ensure that individual team members have access but also face the challenge of communicating and coordinating across disabilities [27] since ensuring the inclusion of all people within the workforce is one of the critical matters in terms of equity [27, 44]. Therefore, to understand the challenges in creating a cross-disability solidarity-oriented virtual workplace, we conducted ten in-depth interviews with a unique mixed-ability team (which includes people with physical disabilities: a deaf person, two blind people, a low vision person, three people with different mobility impairments and three people without disclosed disabilities) working in the same virtual workspace in Turkey.

We ask the following research questions: 1) How does a mixed-ability team collaborate to work together virtually? 2) What are the challenges a mixed-ability team experiences while creating an accessible virtual workspace, and how do they solve them? 3) How might virtual collaboration tools better support mixed ability

teams collaborating? Our findings contribute to this existing literature on mixed-ability collaboration in two ways: 1) by showing the challenges of a unique mixed-ability social entrepreneur team from Turkey that manage long-term cross-disability collaboration and create an accessible virtual workspace, and 2) by providing implications for virtual collaboration tools to better support a cross-disability collaboration, based on disability justice.

2 BACKGROUND

To help the reader, we provide brief contextual information regarding disabled people's access to the work environment in Turkey, where the current study takes place. Further, this subsection brings together related work on disability justice, mixed-ability collaboration, and accessibility at teamwork.

2.1 Disabled People's Access to the Work Environment in Turkey

Only 22.1% of disabled individuals in Turkey participate in the labor force [10]. The lack of necessary laws and practices regarding special and primary education, vocational education, rehabilitation, care services, and employment policies are among the reasons [30]. As is the case worldwide, remote working opportunities are presented as essential employment opportunities for the disabled community in Turkey [4]. However, it is documented that the inaccessibility of the remote work environment is not even considered by employers and the law [4], which echoes the results of U.S.-based studies [13]. Our research engages in a unique mixed-ability social entrepreneur team that delivers accessibility consultancy and manages cross-disability collaboration. We contribute to the HCI field with a case on the virtual work experience of such a mixed-ability team in Turkey. While our research is situated in Turkey, and we closely observe any locality-related or cultural differences, the focus of our paper is not on the locality of the study.

2.2 Disability Justice and Collaboration

Disability justice is a justice-oriented concept pioneered by disability justice activists [23, 29, 32]. The framework includes the principles of disability justice, a celebration of disability and disabled people with a focus on the leadership of "disabled people of color and of queer, and gender non-conforming disabled people" [23]. As an important framework, disability justice is also used widely within academia, as well as in HCI research around disability and accessibility [3, 35, 39]. In a recent CHI workshop on disability justice, scholars criticized existing assistive technology research in HCI which may not always attend to the complex lived experiences of disabled people and why the perspective of disability justice is crucial for accessibility research [39]. Disability justice provides some principles to guide researchers, practitioners, and activists towards more equitable movement building: intersectionality, the leadership of the most impacted, anti-capitalist politic, commitment to cross-movement organizing, recognizing wholeness, sustainability, interdependence, collective access, collective liberation, commitment to cross-disability solidarity [23]. We examine three principles in more detail closely related to our study.

2.2.1 Collective Access and Interdependence. Disability justice work from activists such as Mia Mingus discusses "collective access" as collectively re-thinking how disabled people engage in movement spaces concerning interdependence, which is about creating solidarity and liberated space [29]. In HCI, a growing number of studies indicates a non-static definition of access that includes interactions, body, and negotiations [3, 7, 41]. Branham et al. highlight the accessibility processes as not static, changing over time, and continually being negotiated by people who share the same space [7]. Thieme et al. consider disability as created through a person's social and material interactions with the world [41]. Wang and Piper illustrated that accessibility emerges through interactions and practices [43]. Bennett et al. show that access needs to be "continually renegotiated" based on social norms through social interactions [3]. Overall, the situational and collaborative nature of the disability and the accessible experience are dynamic and include people with different abilities (mixed-abilities) [6, 20, 46]. Recent work has noted the collective and interdependent nature of constructing access [3, 41], often in mixed-ability settings. The collective access principle of disability justice defines access as: ".... we bring flexibility and creative nuance to our engagement with each other. We create and explore ways of doing things beyond able-bodied and neurotypical norms… We can share responsibility for our access needs…" [23]. Closely related to collective access; the interdependence principle also highlights "...to meet each other's needs as we build toward liberation [23]."

2.2.2 Cross Disability Solidarity. Cross-disability solidarity is defined as: "...building a movement that breaks down isolation between people with physical impairments, people who are sick or chronically ill, psych survivors and people with mental health disabilities, neurodiverse people, people with intellectual or developmental disabilities, Deaf people, Blind people, people with environmental injuries and chemical sensitivities, and all others who experience ableism and isolation that undermines our collective liberation [23]." Considering that the social and disability justice-based HCI work focuses on increasing active participation and wellbeing of disabled individuals in daily life and working spaces, how cross-disability dialogues and collaboration built or supported in these spaces gain more importance. Overall, we aim to contribute to disability justice-oriented HCI work by focusing on cross-disability collaboration and solidarity by examining a mixed-ability team in Turkey.

2.3 Supporting Mixed-Ability Collaboration

Confirming Mingus's work on intimacy and interdependence, a good portion of mixed-ability work in HCI also highlights the importance of interdependency and trust in mixed-ability collaborations. It is important to understand and design new systems to facilitate collaboration for mixed-ability people [13]. A growing body of literature within HCI investigates how mixed-ability people collaborate in various tasks such as photo sharing [28], shopping [47], gaming [19], navigation [45], storytelling [12], paddling [2], music making [31]. Branham and Kane [6] argued for technologies at home to foster collaboration between blind and sighted partners, considering accessibility as collaborative and socially constructed. A recent CHI paper also examines patterns of domestic VA use in

mixed-visual-ability families and illustrates similar findings around interpersonal relationships, domestic labor, and physical safety [36]. Beyond individuals accessibility needs, Storer et al. also highlights complex social interactions [36]. Focusing on mixed-ability collaboration and interdependency in a gaming environment, Gonçalves et al. showed how the interdependence of the roles in the game required participants to figure out a way to communicate effectively and trust each other's judgment [19]. In order to build the trust in mixed-ability collaborations, Williams et al. highlight the importance of building awareness, advocacy, and empathy [45], while on the other hand Baldwin et al. emphasizes facilitating rapport and trust through reciprocity and interdependence for paddling experience co-designed by a mixed-ability team [2].

These studies further made connections to technology and tools to enhance the shared experiences by mixed-ability people around various collaborative activities, since it is important to understand and design new systems to facilitate collaboration for mixed-ability people [13]. Studies show how mixed-ability people use different tools and platforms such as voice assistants [36], social media [28], music making interface [28] or navigation device [45] to build interdependence, trust and collaboration. Their findings show that collaborative tools may provide templates for generating alternative text [24, 28] to ease the mutual use without extra effort, or assistive technology may be used to better inform mixed-ability partners while shopping [47] to use interpersonal knowledge effectively and build trust to better support collaboration. Highlighting the social aspect of assistive technology use, Thieme et al. emphasize the importance of assistive technology in building and maintaining social bridges, not aiming to replace human assistance [41].

Overall, through various cases, recent studies highlighted how looking into mixed-ability collaborations has strong potentials to inform us about co-creation, trust, empathy, flexibility, interdependence, and building effective tools to improve social interactions, giving valuable insight into any collaborative technology and tool design. These studies illustrated how technology suggestions like automatised templates, alt text, and similar technologies can enhance human life and contribute to equal participation, while strengthening trust and interdependency in mixed ability settings. This stream of studies inspire our work to discover how these highly contextualized concepts may look like in another setting like Turkey throughout the long term interactions of a mixed-ability social entrepreneur team that include people with different disabilities, as well as through their interactions with external collaborators in a language other than English. We also aimed to discover how virtual collaboration tools better support cross-disability collaboration, guided by the implications of existing studies on enhancing mixed-ability interaction.

2.4 Accessibility at Mixed-Ability Teamwork and Team Formation

The long-term commitments of a team and its norms can hardly be explained without understanding their team formation. How teams are formed and sustained is a widely explored topic and there are various models to explain the process [17, 18, 33, 42]. One of the most influential and referred models has been Tuckman's description of the stages of development in small groups [5], which explains team formation in four stages of forming, storming, norming and performing [42]. Within HCI, Tuckman's model is also referred to frequently for explaining group formation in virtual settings [15, 34] and for mixed-ability teams [48]. For example, Siregar et al. found how a virtual team engaged in conflict resolution by defining norms for appropriate behaviors until they have their flexible style [34] or Zolyomi et al. found that neurodiverse teams benefit from clearly established team norms and conflict resolution strategies. Also, they revealed that typical team friction points might be different for neurodiverse teams and highlighted the importance of individuality while considering different stages of team formation [48].

Within mixed-ability teams, current HCI literature that looks at how accessibility is created focuses on team members with different disabilities such as deaf and hard of hearing individuals [25, 43], blind and low vision people [7], and cognitive disabilities [9], without a focus on team formation, except from Zoltomi et al. [48]. Previous work presents access at teamwork as a collaborative and social phenomenon [7, 43] and illustrates the importance of co-creation, invisible work, and social practices. Wang and Piper examine coworkers' co-located interaction through various naturalistic tasks and demonstrate how the team co-creates accessibility by engaging in moment-to-moment co-located interaction and emerging team practices over time [43]. Branham and Kane highlight the invisible work of access in a social context by blind and sighted coworkers, showing how access is created in a social context [7]. Further, by looking into the experiences and interactions of deaf and hard-of-hearing Uber drivers, Lee et al. provide design implications based on the existing social practices of the drivers to increase their connectivity with the environment [25]. Identifying access at teamwork as a complex and dynamic process, Cafaro et al. show how societal ability-based hierarchies are replicated in organizational hierarchies [9].

2.4.1 Access in Virtual Mixed-Ability Teams. Although it is promoted as being promising in terms of accessibility in terms of, removing physical barriers in traditional work environments [21] and reducing disability-related discrimination [1], working virtually still harbor many risks of being inaccessible and not inclusive for disabled people due to inaccessibilities experienced in virtual collaboration tools and still existing ableist organizational work culture [13]. Current research provides a comprehensive analysis of accessibility issues people with diverse disabilities and occupations experience using collaboration tools such as collaborative editing and video calling [40]. Linden and Milchus examined worker satisfaction and accommodation needs of teleworkers with disabilities [26], and Tang focuses on the digital representation of the disabled people in telework, providing design implications on how to enhance their experiences, such as using more engaging and active profile pictures when someone's video is turned off [40].

Focusing on work-from-home practices of neurodivergent professionals, Das et al. provide an extensive examination of access needs, such as the burden of creating an accessible digital workspace, negotiating accessible communication practices, and reconciling tensions between productivity and wellbeing [14]. Researchers here discussed the conflicting access needs of different disabled people and provided design opportunities for collaborative platforms to

open a space for more flexibility and customization [40]. Specifically looking at how an ability diverse team (blind and sighted coworkers) engage in collaborative writing using various collaborative writing tools, Das, Gergle, and Piper uncover the factors mediating co-creation of access such as organizational power dynamics, interpersonal relationships, personal strategies or developing new norms [13]. A recent paper provides a unique case of cross-disability interaction by showing how various and sometimes conflicting access needs are managed and negotiated [27]. Here through an auto-ethnographic methodology, Mack et al. discuss how co-creating accessibility in a mixed-ability team during an internship process is affected by power dynamics. They also reveal difficulties in remembering accessible practices in a context where various accessibility needs emerge and change during the interaction process and sometimes conflict with each other [27].

Altogether, in the light of disability justice that values collective access and interdependence in creating accessible physical and virtual spaces, existing literature focuses on how mixed-ability teams collectively and interdependently create accessibility through continuous social interactions over various collaborative tools. Considering current studies, it becomes clear that the "mixed-ability teams" and "mixed-ability interaction" is majorly defined in terms of how a disability group collaborates with a group of non-disabled people (e.g., sighted and blind coworkers), and how different disabilities interact with each other is significantly less explored. However, mixed-ability teams must not only ensure that members individually have access but also face the challenge of coordinating various and sometimes conflicting access needs across disabilities when team members communicate with each other [27]. Existing studies discussed cross-disability interaction by focusing on interactions of a distributed team with different disabilities and without disabilities [27] as well as interactions of researchers with disabilities from different disciplines [22].

Our study aims to extend these studies on cross-disability interaction by focusing on the long-term -over three years- interactions of a team with different disabilities and people without -disclosed- disabilities who work together in majorly virtual environments and collaborate with external parties. Our work provides details on how the conflicting access needs are handled, how team formation, interactions between the team and external collaborators affect the accommodations. Further, the challenges of the non-western setting, such as the language, bring unique challenges for the use of English-only collaboration tools that are not yet fully addressed in the previous work. Therefore, our findings contribute to this existing literature and the cross-disability solidarity principle of disability justice by showing the challenges from a case in Turkey while creating an accessible virtual workspace and providing implications for virtual collaboration tools that better support cross-disability collaboration.

3 METHOD

We became aware of the practices of the mixed-ability team (which will be referred to as "MAT" through the paper, anonymized) through social media. Afterward, we visited their social media pages and websites to become familiar with their work. They define their aim through their website and social media accounts and present their mission as "A social enterprise that provides coaching for all areas of life to be accessible [Anonymous]." As they illustrate

on their website, they consult a diverse spectrum of institutions, companies, festivals, cafes and restaurants, universities, museums and brands to make their physical spaces, content, services, and products accessible to everyone. They approach accessibility as physical, digital, and social accessibility and give consultations to people and institutions they work on these three dimensions. Also, they aim to ensure accessibility for all disabilities. In order to give such an inclusive consultancy, they wanted to have a diverse team, and therefore create an accessible virtual workspace to accommodate this team where they work together through virtual collaboration tools.

Based on our research questions, we contacted the group via their social media page, and the first author made an initial and informal virtual meeting with the two co-founders. We described our research aim and questions and gave information about the research process. Further, ethical approvals are taken from the University's ethical board. Then we scheduled a time plan for interviews with all team members. Below, we explain our in-depth interviews and engagements with the group, members of the group who participated in our study, and our data analysis process in detail.

3.1 The Study

Our engagements with the MAT started in May 2021. Our study involved in-depth interviews with co-founders (3 people) and other members (7 people). See Table 1. for their disabilities (based on how they prefer to disclose) and their roles and responsibilities in the team. The interviews were about the process of founding or being part of MAT, aims and motivations during their work, experiences of working as a mixed-ability group, how they collaborate, challenges faced, sources, tools, and technologies that are involved in their processes of collaboration, daily routines, and overall interactions. Since the interviews took place during the pandemic regulations, the primary interviewer (first author) met with our participants via Zoom. All of the interviews took place individually, except for two co-founders living at the same house who preferred to be interviewed together (Yağmur and Çiçek). Interviews took around 45-60 minutes, except for the two co-founders interviews, which lasted 120 minutes.

3.2 Data Analysis

All interview records were anonymized, transcribed, and coded by two independent coders (the first and the second author). Grounded in the participants' experiences, we used a qualitative approach in our analysis. We tried maintaining an open and flexible approach with continued analysis and discussion sessions [38]. Data analysis was performed in multiple steps. After the recordings of the interviews were transcribed, first, both authors used open coding to analyze each interview using inductive thematic analysis and carefully followed six steps [8]. After being familiar with the data for each participant, we independently coded the data on the ways that the mixed-ability team collaborates, existing accessibility challenges, and how the collaborative tools are involved in these. After initial individual open coding, we discussed the preliminary codes and themes through collaborative analysis sessions. The initial codes reflected the virtual workspace's features and the mixed-ability team's practices within this. Through continuous collaborative analysis sessions, the final themes are saturated.

Pseudonym of the Participant	Disclosed Disability (Based on how they define)	Roles and Responsibilities in the Team
Yağmur	Mobility impairment	Co-founder. Engineer. Responsible for digital accessibility related processes (digital accessibility analysis and reports).
Çiçek	Restricted mobility and speech difficulty	Co-founder. Communication specialist. Responsible for social accessibility related processes. Involves in consultation processes related to experiences of people with restricted mobility and speech difficulties.
Ekin	Mobility impairment (wheelchair user)	Co-founder. Responsible for physical accessibility related processes (physical accessibility analysis and reports). Involves in consultation processes related to experiences of wheelchair users.
Bulut	Non-disabled	Designer of the team. Finalize accessibility reports, educational materials and social media posts.
Deniz	Low vision	Responsible for projects with external institutions and companies and following funds. Involves in consultation processes related to experiences of low vision people.
Toprak	Total blind	Social media specialist. Involves in consultation processes related to experiences of blind people.
Gül	Non-disabled	Social media specialist of the team.
Barış	Non-disabled	Special education specialist. Involves in consultation processes related to experiences of neuro-divergent people.
Papatya	Deaf	Involves in consultation processes related to experiences of deaf people. Give sign language education to external collaborators.
Umut	Total blind	Involves in consultation processes related to experiences of blind people. Prepare educational materials for the experiences of blind people to external collaborators.

Table 1. Participants of the study along with their disclosed disabilities and roles in the team.

4 FINDINGS

We present our findings under two core themes: 1) Managing the virtual ecosystem: A day in the mixed-ability virtual workspace 2) Negotiating solidarity: Running the mixed-ability virtual workspace. Our data reveal the interactions in a mixed-ability virtual workspace collaboratively created by a social entrepreneur team around the notions of cross-disability solidarity. The quotes presented include the team members' accessibility experiences and teammates reporting each other's experiences. We find this combination important since collaborative access and interdependence highlight how access is created through continuous interactions [7, 13], and allyship is an essential asset of solidarity [27].

4.1 Managing the Virtual Ecosystem: A Day of the Mixed-Ability Team

MAT was founded and started working together during the compulsory transition to a virtual work environment due to the Covid-19 pandemic. The mixed-ability team started to use and rely on collaborative technologies and tools, such as video conferencing and collaborative messaging, while working in the team or with collaborators. This necessity helped them create their bottom-up, accessible virtual workspace and work culture with unique norms. A typical day, how the collaborations take place, and how they define access and build a bottom-up virtual workspace are explained in this part.

4.1.1 Virtual Video Conference Meetings. The day starts with a virtual morning meeting where each member summarizes their plans for the day, makes a division of labor and decides on the scheduling of collaborative tasks, discusses open topics relevant to the whole team, and socializes. The order of the content and the length of the meetings (30 minutes to an hour) vary. For example, if one member has news to share, the socialization part gets longer. These meetings are held via Zoom since it is the team's primary collaborative video call app. Our data revealed some individual accessibility issues while using Zoom such as the written names of the participants being too small for the member with low vision or difficulties in adjusting the camera for blind members. Other members generally support blind coworkers in adjusting their cameras.

Although internal meetings are fixed, external meetings are scheduled weekly. In external meetings, accessibility issues become more critical. For example, Deniz's problem with the written names negatively affects his active participation during the external meetings (Deniz: "Especially if someone outside of the team attends the morning meetings and I can't remember their name, I cannot address them by name during the meeting."), or Toprak and Umut can not receive support for adjusting their camera from external members. Further, when making calls with people outside the team (e.g., during their collaboration with a company), it may be necessary to use video call platforms other than Zoom (e.g., Teams). As long as it doesn't make a big difference in accessibility, the team adapts any tool or platform suggestions that the external collaborators make. For the platform selection with external collaborators, social features become more important, such as "Seeing everyone in the meeting at the same time (instead of seeing the person who is speaking) is important to catch up when people are talking to each other." (Papatya). This external push of new tools helps explore new platforms and check accessibility. However, if the new accessible feature is not working in practice, the team marks this as inaccessible, such as:

> Papatya: "Actually, I realize that Teams is better because it offers subtitles. But the subtitle is not working in Turkish anyway, so it doesn't work for me."

4.1.2 Collective Communication During the Day. Since the division of labor includes many collaborations (sometimes for content related, sometimes for technical reasons), the team uses collaborative messaging technologies such as Slack and WhatsApp during the day to complete the tasks. Everyone shares their tasks in the text on Slack. All daily communication is carried out on Slack in groups categorized by topic. However, Slack also comes with some accessibility challenges, such as some of the icons becoming invisible when using it with a "high contrast" feature activated (Deniz, low vision). While they think Slack is more professional, they sometimes prefer WhatAapp because it is more accessible to some members through its video chat (Papatya, deaf) and voicemail options (Çiçek, mobility impairment):

> Çiçek: "Slack is partially accessible. Since I have contractions in my muscles, I can choose to send a voice message instead of typing; it is faster for me. Of course, this can be a problem for deaf friends. But Slack doesn't offer a voicemail option anyway."

As our data reveals, these contradictions cause the team to use two different communication tools parallelly, making it sometimes difficult to remember which topic is followed in which tool. As the members highlight, keeping track of which feature of which platform is accessible to which member of the team and acting accordingly also causes extra mental effort and stress while already working at a high tempo. We also realized that many existing and actively used platforms are not fully accessible, and the mixed-ability team adopts the lack of fully accessible alternatives (e.g., Toprak: "We don't know of an alternative that is more accessible, or fully accessible for the team."). Even though they develop familiarity through long term engagement, to keep track of activities, the team 'must' recognise which member can react to which tool, and they

'need to' remember and organize the members in order to not have conflicts due to two disabilities that can not be accommodated at the same time.

4.1.3 Collaborative Editing. As part of the daily routine, the team uses collaborative writing and archiving (e.g., Google Drive), work tracking (e.g., Asana), and collaborative ideation tools (e.g., Miro). During the day, the whole or part of the team needs to work on a funding application, a proposal for a collaborator, or ideation about an ongoing project. Video conference meetings sometimes support these activities, but sometimes the team just works on shared documents synchronously or asynchronously. The common accessibility issues in these platforms (especially Miro and Asana) are they require too much fine motor movement, which is a challenge for some members (Çiçek, Yağmur). Others also mentioned that leaving comments on Google Docs becomes an accessibility issue, especially for the blind and low vision members. Finally, contextual accessibility issues such as language barriers were visible since many technologies with English infrastructures (e.g., Slack, Asana, Miro) become inaccessible because they are not suitable for Turkish screen readers of blind coworkers. Due to this inaccessibility, some of the tools were eliminated during in-team practice. (Deniz, low vision: "I don't know why Miro was chosen. It's challenging for me as a low-vision person. We didn't use it as a team anyway while I was there.") Or, some tools were replaced with more accessible ones despite their different functions. For example, while Asana is mentioned for work tracking, Slack is used at the end to track the division of labor since it is considered more accessible by many members.To collaboratively edit documents or ideate, the team 'prefers' sacrificing the fancy tools, and they 'appropriate' their trusted tools such as Slack beyond the initial intention of the tool.

4.2 Negotiating Solidarity: Running the Mixed-Ability Virtual Work Space

Running a mixed-ability virtual workspace that includes the cooperation of people with diverse needs required MAT to define access for the team and balance their priorities to make decisions around access, manage conflicting access needs, and collaborate.

4.2.1 Thinking Collaboratively about Access. When they came together as experts with different abilities, the team also began to forge a bottom-up and shared definition of accessibility through various practices during collaborative work and efforts to negotiate solidarity. As they put it, "To make this city an accessible one, we first create an accessible workspace in MAT." (Barış). By the team, collective accessibility was defined as a "constantly changing process" (Bulut) that "needed to be talked about frequently" (Deniz). As a result of their interaction, they had the chance to observe many different experiences apart from their own disability experiences. The definition of accessibility they created during this learning process is a collaborative one that emphasizes "not leaving anyone out" (highlighted by all participants). They consider it "possible and necessary, even though it may be difficult to create" (Ekin). Following is an example of how they define collaborative access, considering both their virtual work environment as well as the perspective while they give consultancy to different foundations:

Yağmur: "The basis of accessibility is already non-segregation. You clash with the concept of being accessible when you make something accessible only for a single disability group."

Çiçek: Through observation and constant interaction, everyone in our team expands their vision on different disabilities and needs. I think it's something worthwhile; everyone in the team is transforming while we guide other people."

Further, the MAT needs to consider the different needs of disabled people and define accessibility accordingly. But they also mentioned that beyond the different physical and digital needs, social issues that they experience, such as prejudice and disrimination (e.g., Ekin: "The way that they are being excluded from the workforce and employment"), are shared among all of them. Therefore, they "...need accessible infrastructures and technologies in workspaces, as well as to practice working together" (Yağmur).

4.2.2 Balancing Priorities around Access. We observed that to ensure solidarity, the team works to balance internal and external, as well as individual and collective priorities. Working with external companies with more top-down, traditional work cultures that majorly do not prioritize accessibility, the mixed-ability team needed to keep pace with their practices while trying to create a bottom-up work culture that values accessibility.

Yağmur: "We've selected the best platforms for the job to be more professional. I must admit that we don't consider accessibility much in that process."

Bulut: "Platform choices were generally made in line with our communication needs and to be well integrated with the companies we collaborate with. Since there are individuals from different disability groups in the team, we considered the accessibility of applications to be used jointly. However, practical and shared use may have precluded accessibility. For example, we did not switch to another platform although blind members have difficulty commenting on Google Drive documents."

Here, there seems to be a contradiction between being accessible for the internal team members and using mainstream tools to easily collaborate with external team members. As our data highlights, at that point, the team develops some strategies to manage priorities, which are mainly collaborative. For example, as Barış puts it, "Blind co-workers drop comments via others since leaving comments on Drive is inaccessible to them." Since the accessibility issues that the team experiences are solved or considered solvable through collaborative practices inside the team, fast and easy collaboration with external collaborators sometimes becomes more important and prioritized. For example, when an external collaborator shares an inaccessible PDF document or a picture, MAT makes it accessible (e.g., using accessibility tools or providing a description) to distribute it within the team. As Toprak said, "We do not force them (external collaborators) to be accessible in every action while they work with us." The accessibility that is not offered by the collaborative technologies seems to be compensated through collaborative accessibility practices of the team over time. For this, some of the

team members prioritize attending meetings that are with external collaborators:

Ekin: "We learned to work together and meet everyone's needs. We gave training about the platforms we use to each other, or we support each other while we use the technologies. How to do this is not written anywhere; we learn through experience. Everyone is surprised when we tell the institutions and companies we work with these processes."

There are also some instances in which the team may not be able to solve access problems within the team. Our data illustrates one example of such a situation when a team outsources someone to ensure accessibility, such as a sign language interpreter to support Papatya (a deaf member) during the meetings. Further, the team also expressed instances where the external collaborators asked if they could ensure accessibility for the members of MAT, especially if they form long-term relationships, and therefore the external collaborators had a chance to "get to know the team better (Yağmur)." As our data also reveals, working with external collaborators or working within the team, creating a collaborative work culture within the inaccessible infrastructure (e.g., collaborative technologies) requires different degrees of flexibility and adaptability. These in turn, led to the creation of a work culture that is outside of mainstream work culture practices, such as "Çiçek: We write our WhatsApp and Slack messages based on how the screen readers work." [writing a long message and sending once the message is finished, instead of sending consecutive words or sentences as separate messages] or choosing not to turn on videos during meetings:

Deniz: "In general, I want to attend meetings with my video turned off because my forehead appears on the screen when I bend over and approach the screen while screen sharing or taking notes. Not cool. We tried to make an add-on that automatically turned off the camera when someone approached the screen with the image processing APIs, but it didn't work. The team solves this with their understanding. For example, no one forced me to open my camera at MAT in Zoom."

One exception to this flexibility appears when turning videos on required for the collective access when Papatya needed to see people for lip reading. Since beyond being diverse, different accessibility needs sometimes become conflicting when it comes to building collaborative access for the mixed-ability team. Negotiating solidarity requires managing individual and sometimes conflicting access needs and ensuring access for the team.

Yağmur: "When you only consider a single disability group, something 'accessible' you do creates inaccessibility for other disability groups. So you need to think by widening your perspective."

Similarly, the team cannot consider any collaborative technology accessible for the whole team since an accessible feature for one becomes an accessibility challenge for the other. Even though there are fewer problems when a non-disabled team member communicates or works with a disabled team member, things become more

complicated when members with different disabilities work with each other:

> Umut: "In our WhatsApp group, I try to send a voice message, but it doesn't mean anything to our deaf friend. But if she sends me a photo, it doesn't mean anything to me. As a team, every member is aware of these and acts accordingly."

While trying to build collaborative access within the team, the MAT also believes their practices provide valuable implications for the disability community in Turkey, a community that is also resourceless in terms of technology use, digital literacy, advocating for fundamental rights around accessibility and international interactions. The team is aware that the work environment and culture they build are unique, especially in Turkey. Overall, beyond what the existing technologies and practices provide for ensuring accessibility, our data illustrates many instances where they need to invent bottom-up, unique practices for balancing priorities to ensure solidarity.

5 DISCUSSION

As the previous literature highlights, mixed-ability teams must not only ensure that members individually have access but also face the challenge of coordinating various and sometimes conflicting access needs across disabilities when team members communicate with each other [27]. Through our discussion, we reflect on findings from our unique setting of a virtual workspace, a combination of well-known virtual collaboration tools with default English settings. The team involves multiple people with varying abilities working together long-term and interacting with external collaborators as a social entrepreneur team in Turkey. Our study contributes to existing studies around disability justice [39], highlighting how access is created through collaborative and creative efforts of mixed-ability group members [7, 13, 14, 40] and how existing and emerging technologies can support these practices.

5.1 Towards Virtual Collaboration Tools to Support Cross-Disability Solidarity

The tools are reflections of a society and its norms. Previous work illustrated how accessibility is created through tools, technologies and socio-technical systems situationally [46], interdependently, collaboratively [3, 6, 7] and through social interactions, [13, 14, 27, 41]. Our work showed how virtual collaboration tools shape the work of the MAT and how the MAT shapes the uses and functionality of existing tools by constant collaboration and team solidarity. According to disability justice, the participation of all community members, people with diverse disabilities who experience ableism and isolation, are valued and honored [23]. As a result, virtual collaboration tools of mixed ability groups like MAT should also reflect these qualities. Based on our insights, we argue that to better support cross-disability solidarity-oriented mixed-ability teams, virtual collaboration tools should: 1) Center collective access and conflict resolution with team formation 2) Ensure balancing external power dynamics, and 3) Build features that support language and cultural diversities.

5.1.1 Center Collective Access and Conflict Resolution with Team Formation. Developing new group norms around accessibility through collaborative efforts of mixed-ability members of the team presented as one of the strategies of creating access illustrated by previous work [13, 27]. Our study shows that the MAT strives to achieve a bottom-up work culture and new norms that is based on cross-disability collaboration (e.g., internal morning meetings without a precise duration, constant peer support, members appropriating diverse technologies based on the needs, flexibility in terms of access needs and daily practices). However, the existing tools are under-equipped to support the practices of the MAT. To begin with, we imagine some design improvements for the virtual collaboration tools. For example, video conferencing platforms may provide feedback for blind participants when they want to turn on their camera and adjust their angle, providing opportunities for adjusting the written displays. Instant messaging tools may provide features such as instant transcription of audio messages. Without the virtual tool assistance, the team needs to build practices to create access for all members. Nevertheless, beyond practical accessibility improvements, we argue for design improvements for collaborative tools to foster collective access centrally. Design improvements should help prioritize collective access needs based on the cross-disability solidarity of the members.

It is already highlighted that access in remote workspaces for disabled workers revealed conflicting access needs [14] and technology in its current form does not "make space for these conflicts, nor does it facilitate the art of thoughtful compromise in access work [22]." Previous work also showed how complex social interactions should be taken into consideration by designers, to have a more holistic approach to the lived experiences of people with disabilities, instead of focusing individual access needs [6, 36]. Similarly, our study showed how focusing on individual access needs sometimes results in conflicts within the team. This echoes Mack et al. on how conflicts arise when different people with disabilities and differing access needs working together [27]. For example, in our findings, Çiçek prefers to send a voice message instead of typing due to contractions in her muscles, but her messages become inaccessible to Papatya. Or, Papatya's need for lip reading becomes an uncomfortable request for Umut, Deniz, and Toprak. While features of the collaborative virtual tools are considered accessible for one disability group, they are not accessible, or they even create an access barrier for other groups. Therefore these tools are considered partially accessible, not fully accessible, or inaccessible by the mixed-ability team. This is in line with the commitments of disability justice [23] and the design principles for all [37].

Interactions of the MAT are an important source to learn from. They can inform us on how to deal with and resolve conflicting access needs, especially with the help of team formation. The long-term interactions are resourceful for understanding the potential of centering collective access. Based on the team formation processes presented by Tuckman, the MAT best fits in the norming stage [42], considering that the members are constantly creating new ways of doing and being together over a three-year process. Existing studies already showed how interpersonal knowledge arises through long-term relationships and shared knowledge of daily practices between mixed-ability partners facilitates collaboration [47]. Distinct examples of the norming phase in team formation for the MAT

would be the effective conflict resolution skills, acceptance of all members in the team as they are, development of a non-hierarchical decision-making process and developing team routines [42]. The MAT engages in the long-term experience of working with flexible patterns of managing accessible internal collaborations. Both high interpersonal knowledge of access needs and the commitment to developing effective skills for resolving conflicting access needs are already adopted and practiced by all the members. By presenting long-term experiences of the MAT that involves people with different disabilities, we highlight the importance of relevant tools and systems that can go beyond the individual access needs of one disability group. These systems and tools (1) can use technologies like machine learning to interpret and respond to long-term, continuous interactions, evolving norms and negotiations to accommodate the conflicting needs of a mixed-ability team.

Our findings also show that the long-term interactions the mixed-ability team built and sustained within the virtual workspace helped them to observe each other more effectively to make their accessibility needs more visible (e.g., Çiçek: "Through observation and constant interaction, everyone in our team expands their vision on different disabilities…"). Therefore, we recommend that virtual collaboration tools should approach these conflicting access needs not just as a challenge to 'resolve' but as an opportunity to become more inclusive and flexible, opening a space for discussions, negotiations, and prioritization of different access needs. For example, tools (2) may record and remind collective efforts of effective communications for mixed-ability teams, such as archiving interaction and collaboration patterns of different ways of resolving the conflicting access needs based on who is involved (e.g., which team members, are they any external collaborators, which features of which tools are accessible for which member, in which circumstances?). Adding features to the tools to memorize the conflicting situations and allowing the members to add their coping strategies can help build an ever-growing library of how to create access on the go. As the previous literature highlights, technologies that fail to support mixed-ability and collaborative use can create missed opportunities for shared experiences, spontaneous acts of kindness, emotional sharing, acts of service, and joint activity [6].

This memory also may guide the members during their practice through different collaborative tools (e.g., sending a photograph is an inaccessible practice for some of the users). This allows them to create a shared and collective definition of access, the collective memory of access needs, and new norms and practices, where they constantly negotiate, shape, and rebuild within the team dynamics. Considering how accessibility is defined as in constant flux in literature [6] and by our participants, we also suggest this access memory be open to discuss all the time and needs to be negotiated frequently [27] and (3) support the team to collaboratively decide on the default use depending on attending member profiles (e.g., We can turn on our videos when necessary. So, remind everyone to turn on their video if Papatya enters the meeting room. We generally try to use video messages that are accessible to everyone and set video messaging as a default option. Or, we meet five minutes earlier than the meeting time with external collaborators to support Toprak in adjusting his camera). These decisions and setups should be flexible, open to constant reconsideration and reassessment between the team members, or team members' interactions with external

collaborators. For this, (4) collaborative tools may collect feedback from the members and external collaborators , providing overall accessibility scores from time to time (e.g. how would you rate the platforms' response to resolve conflicting access needs for a specific case?) and update their adaptability to answer these.

5.1.2 Support Balancing External Power Dynamics. One of the important contributions of our study is to show how a mixed-ability team manages accessible interactions with external collaborators. Our data shows that individual access needs are sometimes overlooked and sacrificed not just for collective access but also to sustain a social enterprise, especially while the team collaborates with external (mostly non-disabled) collaborators. For many external collaborators, ability-first work culture and tools might dominate in defining a virtual workspace. Our study shows how a mixed-ability team still needed to manage and balance their access needs and requirements of being a "professional" team that "integrated well" with external collaborators while balancing ingroup and outgroup tensions. As the previous literature points out, accessibility failures were partly due to the difficulty of remembering different needs in different settings, providing possible solutions when accessibility-related norms of the group are not followed, such as 'reminding' [27]. Considering the constant interaction of the MAT with various external collaborators, it becomes more challenging for them to introduce and negotiate their norms with the external collaborators to work together effectively if the tools are not designed from a cross-disability solidarity perspective. As MAT does not prefer to "force" the external collaborators to consider accessibility, they solve accessibility issues within the team during their collaborations (e.g., the team makes the sent documents accessible and distributes them). We suggest virtual collaborative tools be ready to support how technology is socially appropriated, such as (1) providing features for experience and know-how sharing opportunities within the team as well as with external collaborators.

It is previously illustrated that individual team members with a disability need to manage their access needs and social and professional norms of being a 'good' worker [13]. Also, power-relations and presence of hierarchy within the team affected how accessibility accommodations applied [27]. As our data illustrates, some tools are not preferred by MAT since they are not accessible to a part of the team (e.g., using Slack instead of Asana for work tracking or using WhatsApp even though "Slack is more professional"). But some other tools are still preferred even though they are not accessible to a part of the team (e.g., not switching to another platform although blind members have difficulty commenting on Google Drive documents) since they are needed for external collaborations. Even though there are less power-relations and less top-down hierarchies within the team, work cultures of external collaborators or power-relations between MAT and collaborators affected how accommodations are applied in collaboration processes. Regarding supporting the existence of a mixed-ability team as a social enterprise and accessibility 'professionals', the virtual collaboration tools must integrate and promote accessibility as integral to inclusive professionalism and promote accordingly. For example, collaborative tools (2) may provide opportunities for guidelines for accessibility features or accessibility check when an individual or a team sign in.

Our data show the instances where the team only openly discusses the inaccessibility issues with external collaborators if MAT has long-term and close relationships with them. This echoes previous literature highlighting familiarity and comfort as determinants of how workers with disabilities negotiate accessibility with their collaborators and managers [13]. We believe it is valuable to show how power dynamics, social pressures, and stigma around negotiating access replicate itself beyond interpersonal relationships, extending through relationships between the teams. Here, we suggest each tool (3) provide an overview of their accessibility decisions so that this can be shared with external collaborators. For example, collaborative tools (4) may inform the external collaborators about the accessibility needs and decisions via an email before they meet with a mixed-ability team or start a collaboration. As previous literature highlights, this may help our group members adapt more easily while establishing accessibility as an essential group value [27]. This may help rupture the ignorant ability-first work cultures; supporting the team nurture the ideals of being a good social enterprise does not necessarily mean working in inaccessible environments.

5.1.3 Support Language and Cultural Diversities as a Part of Interdependency.

As previous literature in mixed-ability work environments also highlights, simply creating accessible technologies does not guarantee that these will be available or adopted and access does not reside in the specific technology features [7]. Instead, it is created through interaction within the group dynamics, which also depends on the context [16]. Considering previous studies on mixed-ability interactions majorly take place in western contexts [7, 13, 22, 27], our study reveals many insights in terms of how characteristics of non-western context (language, culture, socio-political environment) shapes the functioning of mixed-ability teams like the MAT. Our findings show a bottom-up culture that the team developed to virtually collaborate, such as social practices to appropriate inaccessible and partially accessible technologies through working interdependently (e.g., supporting each other while using tools), using technologies differently (e.g., writing based on how the screen readers work), outsourcing (e.g., sign language interpreter), showing flexibility (not fixed rules, showing understanding) or sharing know-how (e.g., internal training).

Language is an important point related to context and our data revealed some language-related accessibility challenges. It should be noted that the native language of all of the MAT members is Turkish and the majority of the members are not fluent in English, which is the primary language of many of the collaboration tools the team frequently uses. For example, even though some video-conferencing tools provide real-time captioning opportunities, these do not work correctly in Turkish to support team members like Papatya. We recommend virtual collaboration tools should also consider accessibility accommodations such as (1) captioning to work across languages or embed the assistance in the chosen language, such as automatic activation of avatars to support lip reading and (2) text-to-speech translation that helps seamless communication in the chat to help the team value all members equally. Further, blind or low-vision members who use Turkish-based screen readers like Umut, Toprak and Deniz have difficulty adopting these

tools, making them inaccessible to the whole team when they want to meet or collaborate.

Challenges are also applicable when the team collaborates with external team members, especially with the disabled community. Considering the limited education and employment opportunities that people with disabilities have in Turkey, many community members have limited access to technologies and knowledge of technology use. Language becomes an additional barrier to these. Therefore, MAT members also have struggles when they want to interact and collaborate with external members from the disability community, considering the physical inaccessibility of the city and the technical inaccessibility of virtual tools. Therefore, we recommend (3) virtual collaboration tools to provide opportunities for customized features around language, (4) provide accessible tutorials in various different forms (e.g., accessible videos, visuals and texts) and languages for users to improve themselves and support their cross-disability collaboration as a community.

6 LIMITATIONS AND FUTURE WORK

Some limitations of this study are acknowledged in this section to encourage future work. We are aware that how "mixed-ability" is defined and what the term covers may change based on the context. Even though our case involves a team where different disabilities are represented, many other disabilities are excluded, such as neurodiversity. We provide this as a limitation and a crucial direction for future research. Future work should examine diverse mixed-ability teams in different contexts and through different interactions. Also, our work revealed some but limited context-related findings. Therefore, we encourage future research to look at cross-cultural mixed-ability collaborations to focus more on the cultural and contextual nuances and how they might be negotiated while co-creating access.

7 CONCLUSION

To better understand the challenges in a mixed-ability virtual workspace dedicated to ensure cross-disability solidarity, we conducted ten in-depth interviews with the members of a unique mixed-ability team with. Reflecting on our findings, we discuss design implications for virtual collaboration tools to better support cross-disability solidarity-oriented mixed-ability teams by centering collective norm making around access, balancing external power dynamics, and supporting language and cultural diversities. Overall, this paper contributes to the existing literature on mixed-ability collaboration by adding a case showing the interactions of people with different physical disabilities following cross-disability solidarity principles of disability justice. Our work shows the challenges a mixed-ability team experiences while creating an accessible virtual workspace. Design implications are listed for virtual collaboration tools on sustaining the emerging virtual workspaces for better support of cross-disability collaborations.

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