UNIVERSITY OF COPENHAGEN
DEPARTMENT OF COMPUTER SCIENCE

PhD Thesis

Valeria Borsotti

MAKING TROUBLE

Reconfiguring Equity & Accessibility in Computer Science

Supervisor: Pernille Bjørn

Submitted on: January 16, 2024

Name of department:	Department of Computer Science
Author(s):	Valeria Borsotti
Title and subtitle:	Making Trouble: Reconfiguring Equity and Accessibility in Computer Science
Topic description:	This dissertation explores challenges and opportunities for equity and accessibility in computer science through an action-oriented, ethnographic approach.
Supervisor:	Pernille Bjørn
Submitted on:	16 January 2024
On the cover:	A photo of the 'porn toilet', the bathroom for people with disabilities at the student café for students of Computer Science, Maths and Physics at the Faculty of Science, University of Copenhagen. Photo taken by the author in 2022.
Number of characters:	29657

Summary

This dissertation explores challenges and opportunities for equity and accessibility in computer science through an action-oriented, ethnographic approach. To do action-oriented research on equity in computing is to make trouble, by identifying and disrupting normative structures and dynamics, and by giving visibility to bottom-up, collective strategies for change that fall outside 'the norm'. This project is both *norm-critical* and *norm-creative*. It examines how norms and values are (re)produced in institutional spaces through sociomaterial practices, data and artefacts (norm-critical analysis), and it generates change at different scales, within and without the department (norm-creative mode).

The project highlights the intricacies and potentialities of enacting Diversity, Equity and Inclusion (DEI) work in unstable and open complex cooperative settings, expanding the traditional empirical domains of CSCW research. It also expands the scope of DEI work in computer science by including disability, an area long considered "a different diversity" (Kim & Aquino, 2017). The analytical framework interweaves CSCW, feminist technology studies, organization studies, and critical access studies. Based on a three-year ethnographic engagement in the Department of Computer Science at UCPH (DIKU), this dissertation aims to answer two research questions:

RQ1: How do sociomaterial practices, data and artefacts shape how equity is configured in computer science education?

RQ2: How can we re-orient cooperative practices to support equity in computer science?

This dissertation's contributions can be divided into four parts: 1) an intersectional exploration of barriers and opportunities to equity and accessibility in computer science; 2) new strategies to re-orient institutional efforts towards DEI (such as *access grafting* and *equity-focused institutional accountability*); 3) a methodology of *ongoing formative critique* and 4) a broadening of CSCW concepts by proposing access labor as an extension of articulation work, centering how non-normative individuals encounter systems and organizational practices.

This dissertation includes four articles:

Paper 1 conceptualizes and discusses the process of noticing, documenting, and negotiating institutional change to promote DEI as *ongoing formative critique*. The article draws on two initiatives of institutional change in STEM settings: in engineering in the US (Samantha Breslin) and in computer science in Denmark (Valeria Borsotti). We discuss the affective dimensions involved in this form of engagement and propose five steps for enacting this approach productively.

Paper 2 examines how norms and values around gender and race are (re)produced in the traditions of humor at DIKU, as they are encoded in sociomaterial artefacts, digital and physical spaces, and rituals. Using a multi-sited ethnographic approach, we trace stereotyped narratives on gender, techno-capitalism and race. We propose *equity-focused institutional accountability* as an analytical strategy to assist efforts towards DEI in computer science organizations.

Paper 3 presents DOREEN, a norm-critical game of provocations based on a die and a set of adventure sheets. The game invites the players to reflect on stereotypes and gendered norms in computer science education. It also invites reflection on the transformative role of spaces of creative expression in universities.

Paper 4 contributes to CSCW research at the intersection of accessibility and neurodiversity. We examine the invisible *access labor* experienced by neurodivergent students in three Danish computer science institutions. We use an exploratory and multi-stakeholder approach, drawing on interviews with students, teachers and disability officers, as well as document analysis. We map socio-technical barriers in three main areas and document how students improve collective access through micro-interventions. We explore how stigma, intersectional disadvantage and individualized approaches to disability shape critical access to resources, services and opportunities. We propose *access grafting* as a way to reorient organizational practices for equitable access.

Lastly, the dissertation also documents a series of collective actions and tactics for institutional change that have been generated at DIKU as part of this research project.

Resume på Dansk

Denne afhandling udforsker udfordringer og muligheder for lighed og tilgængelighed inden for datalogi gennem en aktionsforskning, etnografisk tilgang. At lave aktionsforskning forskning i lighed i datalogi er at lave ballade, ved at identificere og forstyrre normative strukturer og dynamikker og ved at synliggøre kollektive bottom-up strategier for forandring, der falder uden for 'normen'. Denne projekt er både normkritisk og normskabende. Den undersøger, hvordan normer og værdier (re)produceres i institutionelle rum gennem sociomaterielle praksisser, data og artefakter (normkritisk analyse), og den genererer forandringer i forskellige skalaer, inden for og uden for afdelingen (norm-kreativ modus).
Projektet fremhæver forviklingerne og potentialerne ved at gennemføre Diversity, Equity and Inclusion (DEI) arbejde i ustabile og åbne komplekse samarbejdsmiljøer, hvilket udvider de traditionelle empiriske domæner af CSCW-forskning. Det udvider også omfanget af DEI-arbejde inden for datalogi ved at inkludere *disability*, et område, der længe blev betragtet som "en anderledes mangfoldighed" (Kim & Aquino, 2017). Den analytiske ramme sammenvæver CSCW, feministiske teknologistudier, organisationsstudier og critical access studier.

Med udgangspunkt i et treårigt etnografisk engagement ved Institut for Datalogi ved KU (DIKU) har denne afhandling til formål at besvare to forskningsspørgsmål:
RQ1: Hvordan former sociomaterielle praksisser, data og artefakter, hvordan lighed er konfigureret i datalogiundervisning?
RQ2: Hvordan kan vi re-orientere samarbejdsmetoder for at støtte retfærdighed i datalogi?

Denne afhandlings bidrag kan opdeles i fire dele: 1) en intersektionel udforskning af barrierer og muligheder for lighed og tilgængelighed inden for datalogi; 2) nye strategier til at omorientere institutionelle bestræbelser i retning af DEI (såsom *equity-focused institutional accountability* og *access grafting*); 3) en metodologi for løbende formativ kritik (*ongoing formative critique*) og 4) en udvidelse af CSCW-koncepter ved at foreslå adgangsarbejde som en forlængelse af artikulationsarbejde, der centrerer, hvordan ikke-normative individer møder systemer og organisatoriske praksisser.

Denne afhandling omfatter fire artikler:

Artikel 1 konceptualiserer og diskuterer processen med at bemærke, dokumentere og forhandle institutionelle ændringer for at fremme DEI som løbende formativ kritik. Artiklen trækker på to initiativer til institutionel forandring i STEM-miljøer: i ingeniørvidenskab i USA (Samantha Breslin) og i datalogi i Danmark (Valeria Borsotti). Vi diskuterer de affektive dimensioner, der er involveret i denne form for engagement og foreslår fem trin til at gennemføre denne tilgang produktivt.

Artikel 2 undersøger, hvordan normer og værdier omkring køn og race (re)produceres i humortraditionerne på DIKU, som de er indkodet i sociomaterielle artefakter, digitale og fysiske rum og ritualer. Ved at bruge en etnografisk tilgang på flere steder sporer vi stereotype fortællinger om køn, teknokapitalisme og race. Vi foreslår *equity-focused institutional accountability* som en analytisk strategi for at hjælpe indsatsen hen imod DEI i computervidenskabelige organisationer.

Artikel 3 præsenterer DOREEN, et normkritisk spil med provokationer baseret på en terning og et sæt eventyrark. Spillet inviterer spillerne til at reflektere over stereotyper og kønsbestemte normer i datalogiundervisningen. Det inviterer også til refleksion over den transformative rolle, som rum der giver plads til kreative udtryk spiller på universiteterne.

Artikel 4 bidrager til CSCW-forskning i krydsfeltet mellem tilgængelighed og neurodiversitet. Vi undersøger den usynlige adgang til arbejdskraft, som neurodivergerende studerende oplever i tre danske datalogiske institutioner. Vi bruger en undersøgende og multi-stakeholder tilgang, der trækker på interviews med studerende, undervisere og mennesker med handicap, samt dokumentanalyse. Vi kortlægger socio-tekniske barrierer på tre hovedområder og dokumenterer, hvordan studerende forbedrer den kollektive adgang gennem mikro-interventioner. Vi undersøger, hvordan stigmatisering, intersektionel ulempe og individualiserede tilgange til mennesker med handicap former kritisk adgang til ressourcer, tjenester og muligheder. Vi foreslår access grafting som en måde at omorientere organisatorisk praksis for lige adgang.

To the many people who have shared their stories with me.

Acknowledgements

This project would not have been possible without the vision and enthusiasm of Professor Pernille Bjørn, my advisor. Thank you for your tireless dedication, and for leading me on this exciting and wild journey. You taught me so much more than how to be a researcher! I feel fortunate to be a part of FemTech.dk.

Thanks to Katta Spiel and Samantha Breslin for hosting me during my research visits at TU Wien (HCI) and the Department of Anthropology, UCPH respectively. I have benefitted greatly from discussing with you and I am very inspired by your work. And thanks to my TU Wien and Anthropology colleagues for making my visit both fun and a great learning experience.

Thanks to all the wonderful co-authors who worked with me on the articles included in this thesis: Pernille Bjørn, Andrew Begel, Samantha Breslin, Valkyrie Savage, Jenny Vej and Morten Engell-Nørregård. I have learned so much from each of you and truly enjoyed our collaboration.

To all the people in the Inclusive DIKU program: I am grateful for our work together, and I look forward to seeing Inclusive DIKU 2.0 come to life.

Thanks to DIKU's management: in particular to Jakob Grue Simonsen, Pernille Bjørn, Ken Friis Larsen, Jon Spørring and Ann Søndergaard for supporting this project.

Thanks to my research colleagues across many institutions, in particular to Barbara Carreras, Natalia Avlona, Trine Rask Nielsen, Kellie Dunn, Irina Shklovski, Maria Menendez Blanco, Asnath Kambunga, Maria Athena Campbell, Mirabelle Jones, Sarah Homewood, Naja Holten Møller, Kasper Hornbæk, Kristin Kaltenhauser, Valkyrie Savage and Melanie Ganz for the inspiring discussions and support during this project.

Thanks to Janne Sørensen at the Danish Research Centre for Migration, Ethnicity and Health, UCPH, for hosting me at the center in December 2022 and for the always interesting conversation on diversity and equity at the University of Copenhagen.

Thanks to the HCC community at DIKU, in particular the ever-expanding PhD cohort, for the fun times, the stressful times and for helping each other always.

Many thanks to the great people at the Bevica Fonden for their tireless work with disability justice, and for providing me with new inspiration and new connections.

Lastly, a big thank you to Andreas for your patience, love and support - and to Sebastian for teaching me so many new things every single day!

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INTRODUCTION

"It is through the effort to transform institutions
that we generate knowledge about them"
(S. Ahmed, 2017, p.93)

How this project came to be

Before my PhD, I worked as a Special Advisor on Diversity and Inclusion at the IT University of Copenhagen (ITU), as the very first officer in that role. My experience as a practitioner taught me that working in the field of equity and inclusion in Danish universities involves making sense of a very complex patchwork of regulations and stitching together a variety of actors. As a Special Advisor, I was a *bricoleur* patching up possible strategic initiatives, cross-functional collaborations, conflicting institutional interests and wildly differing motivations and agendas. The ecosystem around any equity-related work in higher ed settings is well captured by Schmidt and Bannon's 1992 description of unstable and open cooperative work arrangements, as they are "characterised by a large and maybe indeterminate number of participants, incommensurate conceptualisations, incompatible strategies, conflicting goals and motives etc." (Schmidt & Bannon, 1992, p. 17). Anybody working with diversity-related issues in Danish universities operate professionally in contexts that lack an overarching strategic framework encouraging and supporting inclusivity and accessibility (see also Research Settings). Regulations and tasks are spread over a variety of areas of concern. In some cases - particularly in regards to disability - the responsibility for action is delegated to specialised caseworkers. Individualising the needs of students through specialised services, however, often implies de-emphasizing collective responsibility for systemic barriers.

Ecosystems of diversity work

As public institutions, all eight Danish universities have a duty to support harassment free environments, promote gender equality and prevent discrimination on the grounds of ethnicity, gender and disability, but there are no adequate and effective mechanisms in place for verifying compliance to regulations. Universities are autonomous, self-governing institutions and there are currently no state audits in the area of equality or equity in universities specifically. However, as

public sector organizations, universities are required to submit a gender equality report every three years[1]. The reports are typically compiled by HR officers and serve the purpose of providing an overview of gender initiatives, so that the Ministry of Equal Opportunities can "monitor" and benchmark institutional compliance with gender equality law. In the latest iteration of this report, institutions were required to answer few questions, list the current gender equality initiatives in place, and present a set of gender (binary) statistics related to the number of current female/male employees. These reports are based on gender-binary understandings of equality in which men and women are understood as homogenous groups, failing to consider how additional dimensions of group identity – like disability or ethnicity – intersect with gender. As a Special Advisor, I often felt like I had to re-align with quantitative and gender binary institutional notions of 'diversity' that were not my own. How could we account for the datasets we were missing? How could we give an account of the symbolic and material ways in which forms of inequality were collectively (re)produced in our organization? Lastly, how could we map and support the invisible work of equity advocates - from students to researchers - and their efforts to propel change?

Academic research has given me the space to explore equity in educational organizations in a different way. My dual role as PhD fellow and first Diversity Chair for my department (read more in Methods) allowed me to extend my research impact beyond academic publishing. In this project I looked at how the practices and materiality of institutional spaces reveal exclusionary values and norms - embracing a "thick" approach rather than quantitative. I also co-created new artefacts, from policies to interactive games - as a way to kickstart norm-creative change.

Diversity as managerial concept and *boundary object*

In her ethnography of diversity work in UK higher education, Sara Ahmed discusses the genealogy of the term 'diversity', reflecting on its original use in the context of US managerial discourse, and explores how it is appropriated by the diversity practitioners she interviews (S. Ahmed, 2012). Ahmed argues that in universities "the languages of diversity are mobilised in various ways by different actors" (ibid, p. 53). In some cases, diversity is perceived as a positive alternative to other terms that make people feel more uncomfortable (racism, for instance), since

[1] Details can be found here: https://www.ft.dk/ripdf/samling/20222/redegoerelse/R7/20222_R7.pdf (last accessed January 10, 2024).

it is vague enough to not have a very precise referent. As she explains: “Diversity does not refer us to something (a shared object that exists outside of speech) or even necessarily create something that can be shared. But in being spoken, and repeated in different contexts, a world takes shape around diversity. To speak the language of diversity is to participate in the creation of a world” (ibid, p. 81). In the context of my work, I see diversity as a *boundary object* (Star & Griesemer, 1989). It moves things around, frames different issues under a common concern, and mobilises cooperation - but it is still vague enough that people understand it in radically different ways, bringing their own visions and understandings. In my role as researcher and Diversity Chair I brought together different concerns and facilitated collaborative sense-making across local contexts, as it is documented in paper 1 in this collection. To do so, I emphasized a focus on *equity* – which requires us to recognize that present inequalities are rooted in systemic issues with complex histories. The concept of equity recognizes *disadvantaged starting points* – which also include marginalizing narratives and practices experienced by people in relation to gender, sexuality, nationality, disability and so on. As such, this work also focuses on accessibility, an area that is often overlooked in mainstream framings of DEI work in computing in Denmark. An equity-focused approach stresses institutional and collective responsibility in preventing and addressing inequalities, therefore opening up new collaborations across organizational units.

Making trouble: from ‘leaky pipelines’ to norm-critical explorations

Much research and policy in the field of ‘diversity in computing’ have been shaped around a metaphor we are all familiar with: the pipeline. This has solidified normative understandings of diversity that are linked with economic growth and competition - understandings that are constantly remade. The 2023 ‘Guide to inclusive computer science education’ published by Microsoft in collaboration with the NCWIT[2] and CSforALL[3], motivates the need to advance inclusion in CS with this statement by Dr. JeffriAnne Wilder:

[2] The NCWIT is a leading US nonprofit organization with the mission to promote gender diversity in computing education.

[3] CSforALL is US consortium launched in 2016 with expertise on policy in CS education, with special focus on K-12. Its steering committee includes the Association of Computing Machinery (ACM), the Computer Science Teachers Association (CSTA), the College Board, and the NCWIT.

"If we are ensuring that there are diverse teams and diverse folks at the table at every step of the pipeline, it creates the opportunity to have tech look like the world that it represents, which benefits us in a million different ways."(Microsoft Philantropies, 2023)

The guide, aimed at educators and teachers, explicitly recommends an intersectional and equity-focused approach to CS education, centering accessibility and culturally responsive curricula. As such, the guide hints at new and emerging areas of focus to make computer science education more inclusive. The statement quoted above is a good example of a slight shift in the dominant 'pipeline' discourse: by broadening participation and ensuring inclusion 'at every step of the pipeline' we create technologies that better represent and reflect a broad spectrum of needs and interests. Historically, arguments for diversity in computing (and other STEM disciplines) have been framed around the *leaky* pipeline, a metaphorical expression introduced in the 1980s by the US National Science Foundation in the context of a predicted shortage of scientists and engineers (Vitores & Gil-Juárez, 2016). The 'leaky pipeline' metaphor represents women and other minorities in STEM largely as untapped potential leaking from an educational and career path that is assumed *abstract and linear* (ibid). As a consequence, initiatives framed within the 'leaky pipeline' rationale are more likely to focus on individual deficit and therefore individual support, suggesting changes such as modifications in teaching, mentorship initiatives and career networks rather than engaging with deeper structural and organizational changes. The idea of a pipeline suggests that by adding proper support, people from different backgrounds will achieve a (linear) career in industry or research, filling the tech jobs that are crucial to our economy. Here I take a different approach, problematizing the so-called 'pipeline' rather than taking it for granted as a neutral entity, and I study my own institution: the Computer Science department at the University of Copenhagen, also known as DIKU.

As such, this PhD project opens up an institutional critique of mundane and often overlooked organizational and epistemic practices that (re)produce normativity in computing in relation to gender, sexuality, ethnicity and disability. This critique has disrupted normative structures and dynamics and generated new ways of enacting DEI work. **Reconfiguring equity in computing means making trouble.** It is by challenging and unsettling institutional traditions and by giving visibility to the transformative efforts of those who typically fall outside 'the norm' that we open up to alternative configurations. It is also by creating new synergies and new collaborations. This work embraces Donna Haraway's idea of *staying with the trouble* as a way to be truly present, to build alliances, to show up and cultivate response-ability (D. Haraway, 2016), our ability to

respond and to “cultivate collective knowing and being” (ibid, p.34). Through this process, the researcher – together with local organizational partners – makes an impact by creating critical points of change.

Research questions

The research questions guiding this project are the following:
RQ1: How do sociomaterial practices, data and artifacts shape how equity is configured in Computer Science education?
RQ2: How can we re-orient cooperative practices to support equity in Computer Science?

The thesis is divided into the following sections:

Part 1: The research context
Part 2: The analytical framework
Part 3: Methods
Part 4: The research articles
Part 5: Conclusion

List of publications

This thesis includes the following publications:

Article 1:
Borsotti, V., & Breslin, S. Ongoing Formative Critique – Working for Equity in Institutional and Interdisciplinary Change. In Krøijer, S., & Mogensen, A.O. (Eds.), *Documenting change anthropologically: the Copenhagen model of impact.* [forthcoming]

Article 2:
Borsotti, V., & Bjørn, P. (2022). Humor and Stereotypes in Computing: An Equity-focused Approach to Institutional Accountability. *Computer Supported Cooperative Work (CSCW)*. https://doi.org/10.1007/s10606-022-09440-9.

Article 3:
Vej, J., Borsotti, V., Savage, V., Engell-Nørregård, M., & Bjørn, P. (2022). DOREEN: A Game of Provocations Creating New Ambitions for Equity in Computing through Intertextual Design. *Nordic Human-Computer Interaction Conference*, 1–8. https://doi.org/10.1145/3546155.3547289.

Article 4:
Borsotti, V., Begel, A., & Bjørn, P. (2024) [*forthcoming*]. Neurodiversity and the Accessible University: Exploring Organizational Barriers, Access Labor and Opportunities for Change. *Proceedings of the ACM on Human-Computer Interaction, Volume TBA, Issue CSCW, forthcoming 2024*.

***

During my PhD I also wrote the following academic contributions, which are **not** included in this thesis:

Bjørn, P., Menendez-Blanco, M., & Borsotti, V. (2023). *Diversity in computer science: Design artefacts for equity and inclusion*. Springer.

Borsotti, V. (2021). Balancing Advocacy and Equity Research in Computing: Notes from the Field. *CSCW21 Workshop Paper* (Presented at the workshop: Activated – Decentering Activism in and with Academia).

Borsotti, V. (2021). Notes on Doing Engaged Fieldwork in a Computer Science Department. Abstract presented at the *Anthropology of Technology Conference 2021* in Arhus, Denmark.

Borsotti, V. (2023). What Can We learn from a Porn Toilet? Alt/tour of a Computer Science Campus. Submitted (not accepted) to AltCHI, *CHI 2023 Conference*.

PART ONE

THE RESEARCH CONTEXT

In order to contextualise my research at DIKU, I will discuss the broader socio-political context in which it was situated. First, I will introduce the current landscape of Diversity, Equity and Inclusion (DEI) governance in Danish higher education. I will then zoom in on the ways DEI work is currently configured at the University of Copenhagen (UCPH) and in other Danish universities.

In the second part of this chapter, I introduce research on discrimination and social justice in Denmark. I will focus on: 1) gender discrimination and LGBTQ+ rights; 2) ethnic discrimination, 'Nordic Exceptionalism' and the legacy of Danish eugenics; 3) disability rights and 4) accessibility and disability in higher education.

The governance of inclusion, accessibility and equity in Danish higher education: a fragmented landscape

Denmark's approach to DEI in education follows the Nordic model of *Education for All* – reflecting an egalitarian idea of society in which participation for all and democratic participation are central, access to free education is guaranteed to everyone, and political measures ensure the distribution of resources to support equality of minoritized groups (Frønes et al., 2020). However, inequitable conditions and outcomes related to gender, sexuality, disability, ethnicity and the socio-economic status of university students in Denmark are pervasive and are often deeply connected (Guschke et al., 2019; VIVE, 2021). Norms around discrimination and accessibility are currently fragmented across laws pertaining to the public sector sphere and tend to have both a *soft-policy* approach and a single-axis orientation. There is currently no strategic framework of Diversity, Equity and Inclusion guidelines for the higher education sector.

The landscape of DEI work is continually shifting, and is configured at the intersection of multiple scales. European regulations layer upon state regulations, and these are filtered through situated institutional dynamics and understandings – all in the context of neo-liberal governance models.

DEI and organizational accountability in the context of the Danish New Public Management

In the last three decades, public sector reforms have encouraged a shift towards New Public Management (NPM) in the governance and management of Danish universities. This shift came after political debates about the 'managerial chaos' and excessive bureaucracy that marred universities, and in the context of a new push to frame universities as engines of economic growth for the nation (Rienecker & Li, 2015, pp. 23–24). According to NPM, universities can learn from governance structures and managerial styles from the private sector, regarded as more efficient. At the same time, the Danish government "tries to control the public sector through so-called output management, i.e., the government defines the objectives, but the specific problem solving is left to local actors" (ibid p.27). According to this model, local institutional management is responsible for developing *the quality* of education, teaching, and study environment, as emphasized in the University Act of 2003. Each institution retains the autonomy to determine *how* best to take preventive or disciplinary actions to guarantee equal access. In cases of discrimination based on gender, sexual orientation, gender expression, ethnicity and disability, individuals may report cases internally or seek legal action upon filing a complaint to the National Board of Equal Treatment (Ligebehandlingsnævnet).

A state law from 2001 emphasized that all educational institutions in Denmark have a duty to guarantee a good teaching and learning environment, including a focus on the "psychological environment".[4] Thus, this includes DEI issues negatively impacting the study environment (as the ones examined in this thesis). But few practical guidelines are offered. DEI is a relatively new area of focus in Danish universities, unlike in other countries - such as the US, the UK or Canada - in which more mature legislative and/or accreditation frameworks have been developed to support diversity and inclusion efforts.

'Danske Universiteter' (Danish Universities), an interest organization led by the Danish Rectors' Collegium to promote cooperation on policy issues, released the very first iteration of its "Principles for Diversity, Inclusion and Equality" only at the end of 2023. The principles, developed through the work of an academic task force, were accompanied by a bullet point list of 8 general recommendations, such as introducing courses in inclusive leadership for university

[4] The regulations can be found here, in Danish (last accessed on January 10, 2024): https://www.retsinformation.dk/eli/lta/2017/316.

staff, using inclusive language and reducing extra service work for gender minorities. The document opens up for discussions of DEI work beyond gender, stating: "The universities acknowledge that gender is not the only relevant parameter for diversity and see these principles as a step towards future efforts to increase inclusion and diversity on multiple fronts"[5]. Although the principles recommend attending to the inclusion of 'underrepresented groups' there is no direct mention of disability, ethnicity/race, sexuality or socio-economic status. Diversity work is still explicitly connected mainly with the category of gender, while other identities and power relations are left unmentioned. In addition, it is unspecified how the principles and recommendations are to be implemented and operationalized. The principles are not binding, as the interest group Danske Universiteter is not a public authority and therefore cannot introduce rules or legislation. The principles are an expression of shared understanding and ambition.

DEI work at UCPH and in other Danish universities: a spectrum of organizational and discursive practices

Despite the uneven configuration of DEI governance nation-wide, all Danish universities now have a Gender Equality Plan (GEP). This is directly related to a mandatory eligibility requirement for EU higher education institutions wishing to participate in Horizon Europe funding from 2022 onwards. Institutions without a GEP would not be able to participate in the grant application process. The plans list actions and policy objectives toward the advancement of *gender equality* – in regards to students and staff. As it is stated in the University of Copenhagen (UCPH) *Gender Equality and Diversity Action Plan* for 2022-2023:

"Overall, the Danish gender equality laws regulate bans on discrimination on the basis of gender, ethnicity, religion, age, disability and sexual orientation. These bans implement discrimination bans from EU law. The action plan ensures that the University of Copenhagen meets the requirements of Horizon Europe for a structural and clear approach to working with gender equality and diversity" (UCPH, 2022, p. 7).

The six action goals listed in the UCPH plan, however, do not explicitly mention ethnicity, disability, religion, age or sexual orientation. The UCPH plan also includes a description of existing bottom-up initiatives that have been created across faculties and departments, mostly

[5] The principles are listed on Danske Universiteter's homepage (last accessed on January 10, 2024): https://dkuni.dk/faelles/principles-for-diversity-inclusion-and-equality-english-version/.

unrelated to top-down centralized efforts or strategies. As such, this PhD project and my work as Diversity Chair (which started roughly 1 1/2 years before the plan became operational) are listed as good institutional practices - together with other similar efforts initiated by staff.

The way DEI initiatives are structured and managed in Danish universities differs wildly from institution to institution. Some universities have an entire team of administrative officers working mostly with a focus on gender-related issues, like the University of Southern Denmark. Others center academic research dissemination and discussion with a clear intersectional approach beyond gender, like the Copenhagen Business School. ITU has set up a D&I committee comprised of managers and releases an annual report focusing mostly on gender. At the time of writing, the University of Copenhagen has two DEI leads and one analyst employed in HR, and one consultant with DEI focus in the Education & Students administrative section. This small team of DEI workers manages efforts targeting over 36,000 students and over 10,000 staff as of 2023 (KU Finance Dept, 2023). In addition, and only for tasks related to the University of Copenhagen's *Gender Equality and Diversity Action Plan* the university has established a governance structure that includes executive managers and academics (see **Figure 1**).

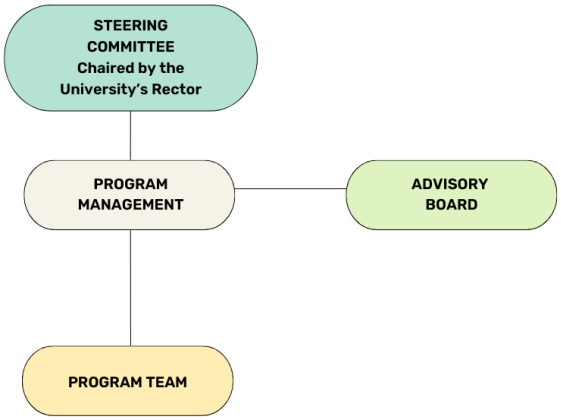

Figure 1: Organizational framework for tasks related to the implementation of UCPH's Gender Equality and Diversity Plan

The steering committee, chaired by the Rector, meets three times a year and is responsible for compliance with the plan. The program management group is coordinated by the two DEI leads in HR and meets weekly. It is responsible for leading and coordinating the projects included in

the plan. The advisory board (which from 2023 includes Professor Pernille Bjørn, my PhD advisor) includes researchers and meets a couple of times a semester, providing professional sparring and new ideas. The program team, which includes all the DEI officers, carries out the initiatives in practice. As mentioned above, the goals of the Gender Equality and Diversity Plan do not explicitly mention any other grounds of discrimination or difference other than gender, but mentions that to "verify and improve data quality and knowledge base with a view to promoting gender equality and diversity" the university will "expand the data base beyond binary gender definitions, including other possible discrimination markers". The University of Copenhagen's webpage on Diversity and Equality frames institutional diversity initiatives in terms of (binary) gender. At the time of writing, gender binary iconography complements UCPH reports and webpages on DEI (see **Figure 2**).

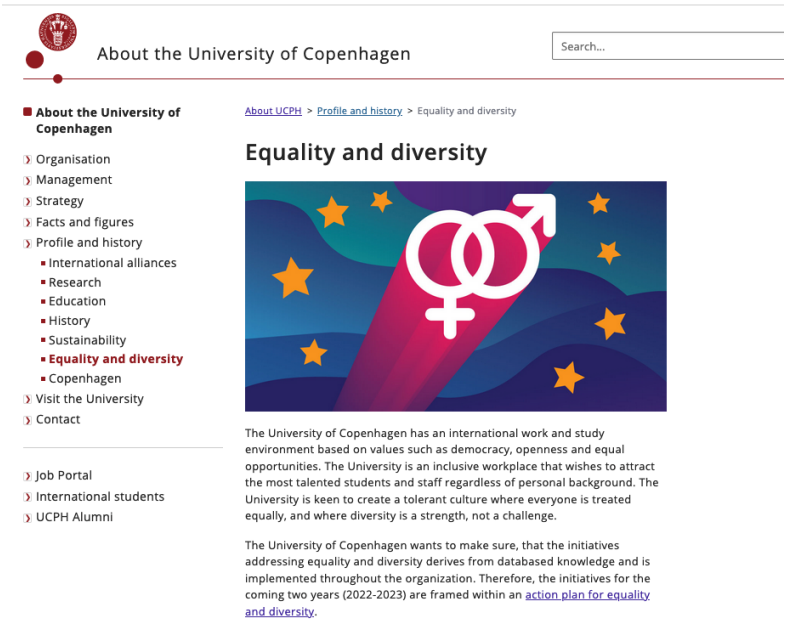

Figure 2: A screenshot of the 'Equality and diversity' webpage of the University of Copenhagen, November 2023.

Equality and diversity in relation to ethnicity, sexual identity, disability, or other social identities aside from 'gender' are not explicitly mentioned on the homepage either (as of November 2023). It is important to note that people involved with DEI work at UCPH range from officers with institutional mandates clearly related to the area, to individuals who have chosen to engage with DEI in their service work, as volunteers and/or in their research. Aside from 'official' employees tasked with DEI responsibilities, a variety of researchers and students are engaged in diversity work, creating networks and committees of their own design, and covering areas that are often not included in institutional strategies, like LGBTQ+ rights, disability, ethnicity-related

initiatives and more. The bottom-up engagement of staff and students in my own institution reflects a broader variety of equity concerns aside from just gender, and this is documented in the GEP document through a list of highlighted good practices.

Overall, when looking at the official institutional approaches to DEI in Danish universities, a focus on accessibility and disability is particularly lacking. As we document in paper 4, disability is largely understood as pertaining to the parallel state system of disability support (called 'Special Pedagogical Support' in Denmark), which is only accessible upon presenting medical or professional documentation.

The concept of "equality" - typically in relation to gender - rather than "equity" is the mainstream discursive frame for institutional diversity efforts in all Danish Universities.

The fragmented and uneven landscape of DEI work in Danish universities reflects a general lack of centralized management and patchy regulations at the state level, which risk causing inequities disproportionally harming specific communities – in particular, those not captured by the focus on 'gender equality'.

Discrimination and Danish state regulations between past and present

The organizational DEI practices we discussed above are shaped and influenced by dominant socio-political structures, and intertwined with a complex web of Danish laws and regulations. To understand how equity and inclusion are configured in computer science education we need to look at the broader context in which local regulations, practices and understandings are situated. In this section I present a broad overview of the socio-political context shaping social justice and disability rights in Denmark - showing how it is constantly being negotiated.

Gender discrimination and LGBTQ+ rights

It is not possible to write about equity in higher education without acknowledging the historical exclusion of entire social groups from the university. Western universities were first established to educate white, male clergy – the earliest universities in Medieval Europe had to be granted a papal bull from the Catholic Latin church. Women were barred from university and college education until the 19th century – Harvard Medical School admitted its first women students as

late as 1945[6]. The University of Copenhagen was founded in 1479 but its first woman student, Nielsine Nielsen, was only admitted in 1877 at the Faculty of Medicine after a royal decree allowed women access to university. However, Nielsine was not allowed to practice her specialty – gynaecology – because the only gynecologist at the time refused to hire her. She later successfully specialized in treating venereal diseases among prostitutes. The faculty of Theology at the University of Copenhagen was the last to admit women in 1916, due to long-standing prejudices on the intellectual capabilities of women, considered to be more driven by emotions than logic[7].

While women are now granted full access to university education, they still encounter barriers. Gender-based discrimination and sexual harassment are prevalent in higher education (Benson & Thomson, 1982) and they disproportionally affect women, particularly women students, ethnic minorities and sexual minorities (Bondestam & Lundqvist, 2020). These results are similar to those reported in Denmark, where a government survey found that women students are significantly more likely than men to experience sexual harassment, unwanted sexual attention and verbal sexism, and 10% of students have experienced discrimination on the grounds of disability, ethnicity, sexuality or religion (Uddannelses-og Forskningsministeriet, 2020). When it comes to perceptions of sexual harassment, gender and nationality are areas where significant differences are found: males and Danish students are less likely to experience and perceive situations as sexual harassment, while different social contexts shape perceptions of sexual harassment, which tend to be normalized if it occurs at parties and social gatherings (Guschke et al., 2019). Cases of gender-based discrimination in Denmark are severely underreported, with only 2% of victims reporting to university administrators, 2% to management and 2% to student counsellors (Analyse & Tal, 2018).

Discrimination based on gender identity, sexual orientation and/or expression, unfortunately affects a large number of LGBTQ+ people in Denmark: according to a recent national survey, 38% of lesbian, gay and bisexual people reportedly experienced discrimination – the figure is

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[6] Read more in this article (last accessed on January 10, 2024): https://news.harvard.edu/gazette/story/2012/04/hard-earned-gains-for-women-at-harvard/.

[7] For an historical account, you can read this article in Danish (last accessed on January 10, 2024): https://www.kristeligt-dagblad.dk/debat/der-kaempes-stadig-med-fordomme-om-kvindelige-teologer.

almost double for trans and non-binary individuals, at 68% (VIVE, 2022). Although it is illegal in Denmark to discriminate based on sexual orientation and/or expression, gender identity and gender characteristics, data from the Ministry of Justice show that between 2000-3000 LGBTQ+ people every year experience violent hate crimes (Justitsministeriets Forskningskontor, 2023). LGBTQ+ people from ethnic minority backgrounds and LGBTQ+ people with disabilities are at an even higher risk of discrimination (Danish Institute for Human Rights, 2023). No comprehensive study on the wellbeing of LGBTQ+ people in Danish higher education is available.

Sexual harassment and gender discrimination are regulated by two laws that are not specifically geared towards educational organizations, though also protect the rights of students and staff at universities: the Working Environment Act (Arbejdsmiljøloven) and the Equal Treatment Act (Ligebehandlingsloven). The Equal Treatment Act (from 1978) builds upon an EU equal opportunity regulation. It regulates discrimination, harassment in relation to sex and gender, gender mainstreaming and equal treatment of men and women among others. An addition to the Equal Treatment Act was introduced following #MeToo, which made a clearer connection between the duty to ensure equal rights on the workplace and prevention of sexual harassment, further specifying that the "tone of conversation" in a workplace is irrelevant in cases of sexual harassment. This means that arguing that an experience of sexual harassment is unfounded due to the "free tone" in an organisation is invalid. But unlike in the US, where Title IX of the education amendment on sex discrimination is enforced by the U.S. Department of Education (Office of Civil Rights) across all institutions receiving federal funding, Denmark has no comparable broad and localized mechanism to enforce compliance with the Equal Treatment Act – leaving students in a particularly vulnerable position.

Ethnic discrimination in Denmark

A growing body of research shows that students from underrepresented ethnic backgrounds are more likely to experience discrimination and microaggressions (Ackerman-Barger et al., 2020; Hill et al., 2020; Sanchez et al., 2018). The same patterns apply in Denmark, where students from underrepresented minorities are more likely to encounter discrimination in their daily lives (Gilliam, 2018; Khawaja & Lagermann, 2022). According to a quantitative pilot study, 16% of Danish higher ed students from minoritized backgrounds who dropped out did so because they experienced discrimination (Hoff & Demirtas, 2009).

Structural racism in Denmark has also been documented in relation to employment practices (Dahl & Krog, 2018), police profiling (Søndergaard & Hussein, 2022), and street-level bureaucracy in the public sector (Andersen & Guul, 2019). According to a report by the Danish Institute of Human Rights (DIHR), 84% of people from a minority ethnic background in Denmark have experienced discrimination or prejudice because of their ethnicity, and 65% have experienced illegal forms of discrimination (DIHR, 2023). The report also states that only 11% of respondents from ethnic minorities who have experienced discrimination reported it. As a result of the report, the DIHR has recommended that Denmark prepares a national strategic plan to address racism.

Deviant from the norm: 'Nordic exceptionalism' and the legacy of Danish eugenics

Classifications and discussions of race and ethnicity in the Danish context present both similarities and striking differences with other countries like the US or the UK. Race and racism in Denmark have been analyzed by postcolonial scholars in the context of 'Nordic Exceptionalism', characterized by a historical lack of critical self-questioning in regard to the Nordic countries involvement in colonialism and racist activities (Loftsdóttir & Jensen, 2016). As Loftsdóttir and Jensen argue, "the interwoven racial, gendered and nationalistic ideologies originating from the colonial project have formed a part of contemporary Nordic identities (…) certain notions and structural inequalities that can be understood as being some sort of residue from the colonial period, become recreated or projected onto different groups in the contemporary Nordic countries" (ibid, p.2). The construction of Danish whiteness is underpinned by the *othering* of some bodies: it reproduces colonial power dynamics through the assignment of values of superiority/inferiority (ibid). Dynamics of othering based on essentialized social categories have also been historically intertwined with scientific and technological enterprises (Morning, 2011). Colonial modes of knowledge production animated the human and natural sciences starting from the 18th century, culminating in the eugenics movement in the early 20th century. The history of eugenics in Denmark is particularly interesting and less well-known. Eugenics policies received wide support by the Social Democratic Party (Roll-Hansen, 1989) and the University of Copenhagen played a crucial role in the development of eugenics research.

There are some traces of this history left on our campus. Right next door to the Faculty Library of Natural and Health Sciences (KUB North) is the address of what was formerly known as the Institute for Hereditary Biology and Eugenics of the University of Copenhagen, established in 1938 with grant money from the Rockefeller Foundation and no longer operational. Eugenics

was a term coined by Francis Galton in 1883 to advocate for the improvement of humanity, becoming "a system for ensuring that the more useful are reproduced more" (S. Ahmed, 2019, p. 98). Eugenics first became the subject of serious academic interest in Denmark when in 1904 the 'Anthropological Committee' was founded, a club of white male scientists that included a rector of the university. 'Racial degeneration' was defined and discussed by members in terms of psychiatric disorders and 'sexual amorality', among others. The Rockefeller funds were directed specifically to Denmark for the establishment of the new Institute for Hereditary Biology and Eugenics, because the country's government was already very active in the categorisation and monitoring of various groups of people due to eugenics principles and concerns (Koch, 2000). The Danish Department of Social Affairs had "large files covering the blind, the deaf, vagabonds, cripples and the feeble-minded" (ibid, p.174). By the time the institute for eugenics was created, ideas on improving the Danish race for the benefit of society had also already been the foundation for some laws passed by the state. As the first country in Europe - even before Nazi Germany - Denmark introduced forced sterilisation of 'abnormal people' in 1929, and in 1934 a law on forced internment of 'the feeble-minded' followed by a law for the sterilisation of other "psychologically abnormal people" (all laws were abrogated in 1967).
Eugenics ideas informed the development of diagnostic tools like intelligence tests (with categories such as 'moron' and 'idiot') and the segregation of people with disabilities in state-run facilities, framing disability as deviance from the norm (Kjær, 2022).

Intellectual disabilities, disability rights and legislation in Denmark

With modern welfare policies in the 1940s and 1950s, people with disabilities became part of public social security but were still isolated in state institutions (Frandsen et al., 2023). Following widespread criticism, the early 1960s marked a shift towards a gradual modernization of the welfare system, going from segregation to the establishment of special schools, sheltered housing and everyday activities that mimicked 'normal' life (Kjær, 2022).
In the 1980s the Decentralization of the Special Care Act established that authorities in various sectors (health, housing etc) were responsible for developing and implementing disability policies. After a 2007 government reform, the responsibility to offer services to people with disabilities locally was fragmented across municipalities. Each municipal executive board defines the service level and the scope of assistance offered, which also includes public primary education institutions. Financial cuts following the 2008 crisis resulted in a progressive de-specialization and loss of knowledge and skills (ibid). Starting from 2019, the grassroots movement #enmillionstemmer (A Million Voices) has become a platform to give voice to people

with disabilities, their families and disability activists to push for better protection of disability rights regardless of municipal boundaries. The historical lack of visibility, participation and recognition of people with disabilities – who have been traditionally segregated from 'normal society' - has shaped how disability is still seen and understood in Danish society to this day, resulting in the design and implementation of services and products largely based on norms and assumptions about what a *normal* user looks like (Frandsen et al., 2023). Recent studies on the digitalization of Danish welfare provision highlight how the inaccessibility of services generates new forms of social inequality (Carreras & Finken, 2022).

The Danish landscape of disability legislation and policy is currently quite fragmented. Disability policy is generally coordinated by the Ministry for Social and Internal Affairs, but development in this area is considered a shared responsibility of all ministries. Implementation varies locally, both across municipalities and within the sphere of responsibility of public sector institutions.

Accessibility and disability in higher education

The year I started this research project marked the 30th anniversary of the Americans with Disability Act (ADA), which protects the rights of people with disabilities in all areas of public life – including higher education. Denmark lacks an over-encompassing regulation like the ADA, and as we discussed, disability rights are regulated by a patchwork of laws. Some of them are fairly recent. The Danish Act on Prohibition of Discrimination of Persons with Disability, for instance, was only introduced in 2018. When it comes to the accessibility of digital products, services and systems, current legislation only cover certain areas: the Web Accessibility Act (implementing the EU Web Accessibility Directive) only requires public sector bodies to ensure accessible websites and mobile apps to provide equal access to services.

This picture gets even more complex if we look at regulations at a higher level, and how they are implemented in practice. Denmark ratified the UN Convention on the Rights of Persons with Disabilities (CRPD) in August 2009. Accessibility is one of the fundamental principles in it: Article 2 of the document states that "States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public" (UN General Assembly, 2006). In the convention, *universal design* is included as a general

obligation: all countries that have ratified it have committed to integrating and developing universal design in research, teaching and regulations. This means that the Danish government has committed to designing products and environments that are usable 'by all people, to the greatest extent possible, without the need for adaptation or specialized design' which shall not exclude assistive devices (ibid). The state agency responsible for monitoring, promoting and protecting the implementation of the UN Convention on the Rights of Persons with Disabilities in Denmark is The Danish Institute for Human Rights. However, in practice, university students with disabilities experience many barriers to inclusivity and accessibility (Uddannelses- og Forskningsstyrelsen, 2022) and to date, there are no guidelines on how to implement universal design in practice.

If we zoom into the higher education sector, disability and accessibility are areas that present many gaps. In 2020, the Danish Ministry of Research and Higher Education sent a so-called "pastoral letter" (in Danish *hyrdebrev*) to all higher education institutions in the Danmark, with an admonition to provide better conditions for students with disabilities, particularly in terms of special accommodations during exams. But implementing any strategic change or preventive measure in universities is easier said than done. In the higher education sector, accessibility and disability are largely framed as individualized 'special' support services that students have to apply for. The Special Pedagogical Support (SPS) system provides special accommodations to people with disabilities in possession of a medical diagnosis or official documentation of disability, as we document in paper 4. The SPS system was first introduced in higher education institutions in 2001. This service is regulated by the Ministry of Children and Education, and SPS officers are located in all Danish universities. However, universities belong to the Ministry of Research and Higher Education, which has no specific regulatory framework or binding guidelines on accessibility and disability in higher education. Universities have to comply with various regulations from different areas – regarding their buildings, web accessibility, protection against discrimination etc. There is currently no knowledge center on disability and accessibility where teachers and staff can find help. As we document in paper 4, many bottom-up initiatives by students with disability and their allies try to fill the gaps. However, disability in Danish higher education is still primarily framed as an individual issue to be addressed by SPS caseworkers with individual accommodations, rather than a collective responsibility shared among university staff at large.

PART TWO

Figure 3: A corner of the DIKU's student canteen, a popular hang-out.

ANALYTICAL FRAMEWORK

The articles collected in this thesis explore issues of inequity in computing education from a norm-critical, sociomaterial perspective. This project allowed me to navigate (and borrow from) a variety of conceptual and discursive spaces, building intellectual bridges across them. In the next pages, I discuss how I used analytical lenses from different disciplines to answer my research questions:

RQ1: How do sociomaterial practices, data and artifacts shape how equity is configured in Computer Science education?
RQ2: How can we re-orient cooperative practices to support equity in Computer Science?

The rich existing literature on values and normativity in computing cultures, reviewed in the first part of this chapter, gave me concepts to think with and helped structure an equity-focused study of sociomaterial practices, data and artifacts in CS education. I drew especially on research from feminist technology studies, history of technology and computing education research (CER). To articulate issues of equity is to bring into play a range of fields of inquiry and topics. In paper 2, for instance, we focus on the role that *humor* plays in (re)producing and queering normativity in computing organizations, weaving in theoretical lenses from philosophy, anthropology and social psychology (these are however not reviewed in this chapter).
In the second part of this chapter, I review concepts from organization theory, CSCW and critical access studies. These allowed me to reflect on how to *artfully integrate* (Suchman, 2002) new equity-focused cooperative practices in the institutions I studied – what data practices need we support, or how can we better address the widely overlooked socio-technical barriers to accessibility? By bridging critical access theory with CSCW concepts (see paper 4), this project also contributes to CSCW by nuancing articulation work with a stronger focus on non-normative bodies in cooperative arrangements.

Values and norms in computing cultures

Constructing 'the norm' in science

Despite a mainstream discourse depicting computing as a neutral enterprise, literature in feminist technology studies has highlighted how gender, sexuality, class, race, disability and technology are deeply historically entangled (Benjamin, 2019; Faulkner, 2001; D. Haraway, 1988; Kafer,

2013; Wajcman, 1991). This body of research challenges understandings of science as 'neutral' (D. Haraway, 1988), highlighting the discursive and social practices through which some identities – male, white, heterosexual, able-bodied – are positioned as the norm in computer science and engineering.

The social construction of racial and gender hierarchies has a close and complex relationship with science. From Darwin's sexist and racist proclamations on the inferior intellect of women, indigenous peoples and of the peoples of Africa (Darwin, 1871) to the more recent remarks by Harvard president Lawrence Summers that innate cognitive difference explains why fewer women succeed in maths and science[8], essentialized beliefs in science have historically devalued certain identities while elevating others as the norm. Normativity – the process of making and unmaking norms – is always mediated and articulated through power relations that are historically rooted. As Haraway puts it: "Only those occupying the positions of the dominators are self-identical, unmarked, disembodied, unmediated" (D. Haraway, 1988, p. 586). Reviewing scholarship on the history of computing as a professional field is useful to contextualize how these power differentials emerged in practice.

'Hot stuff': a historical perspective on gender in computing

The professional field of computer science is shaped by gendered and racialized dynamics at different scales – from the local to the transnational. Although computer science has been historically coded as masculine in professional practices and in the media, computer programming was not originally a male domain (Misa, 2010). Women have been central in the development of early computing in the US and the UK, covering a variety of roles: from the first 'female computers' to leading positions in developing concepts, machines and work practices (Abbate, 2017). The intersection of political priorities, biased managerial strategies and labor constraints have resulted in the structural discrimination and systematic devaluation of women's skills and abilities in Anglo-American computing (Hicks, 2017). Similar patterns have emerged in the US context, where gendered-biased personality profiles and feedback processes used in the IT industry in the 50s and 60s selected for programmers with stereotypically masculine characteristics, while at the same time the "programming community was actively pursuing a

[8] Read more here: https://www.theguardian.com/science/2005/jan/18/educationsgendergap.genderissues (last accessed on January 11, 2024).

strategy of professional development that would eventually make it one of the most stereotypically male professions, inhospitable to most women" (Ensmenger, 2010, p. 237). In the 60s, for instance, the ACM (Association for Computing Machinery) required a 4-year degree for membership, which at that time resulted in excluding significantly more women than men almost right away (ibid).

Normative constructions of gender in computing are always closely related to intersecting social and economic dimensions. Labor, class, and gender intersect in the post-war practices of firing women right after marriage, or the widespread devaluing of 'feminized work'- the rote, deskilled work that was considered best done by women and, despite being crucial, was categorized as affordably priced and highly interchangeable (Ensmenger, 2010; Hicks, 2017). Technology – and what counts legitimately under the name itself - is socially constructed as masculine (Wajcman, 1991). Hicks shows how in 70's tech ads in the UK, women were represented as interchangeable, cheap accessories for the computer, "to assure managers that they could get away with using generic office staff when buying a computer (…) The SUSIE computer 'is operated by a typist – not highly paid programmers and controllers' said the ad copy (…) the fact that SUSIE came with a 130-page programming manual gives some indication of how inaccurate it was to refer as the operator as a typist" (ibid, page 125). The British project of building computer companies in former colonial countries (especially East Africa, India and 'the Far East') was accompanied by the gendered, heteronormative male gaze that informed marketing efforts, with 'exotic' women in tight-fitting dresses portrayed at the machines and presented as 'hot stuff' (ibid).

Hierarchies of value(s) and belonging in computing and engineering cultures

STS ethnographic studies of computer science and engineering workplaces have analyzed how certain perspectives, identities, and kinds of work become less valued, or even obscured – in the professional and epistemic practices of these fields. Diane Forsythe has explored how assumptions shaping the work of (male) AI scientists led them to misinterpret - and even *delete* - the perspectives of the users for whom the AI systems are designed (Forsythe, 2001). By undervaluing or neglecting the knowledge and work of low-status and predominantly women contributors, AI experts created systems that performed poorly, while producing and maintaining gendered power asymmetries. Gender and technology are co-produced (Faulkner, 2001) and mutually shape each other: assumptions about what makes someone an expert or non-expert in technology design and use are often gendered.

Wendy Faulkner's ethnographic study of software developers in a big firm in the US shows how the symbolic and material ordering of work practices result in valuing 'the technical' over 'the social' as the core of the discipline (Faulkner, 2000). Faulkner stresses how this mutually exclusive people/technology distinction is very clearly symbolized in pop culture by the stereotype of the male geek or 'nerd', as someone with a passion for the machine, but no social skills or interest in interacting with people. The social/technical dualism implies that one cannot be both into people and technology at the same time, and the dichotomy is gendered: the narrowly technical roles in computing and engineering are typically coded as masculine, the 'heterogenous' roles are coded as feminine. In practice, however, Faulkner describes how, contrary to the stereotypical assumptions, male and female software developers *in practice* presented a spectrum of behavior and preferences. She explains: "All the women I met enjoyed being totally absorbed with a technical problem, just as all the men took care over their interactions with other people. There are good reasons for these two findings. With respect to feelings about technology, it is clear that no one, woman or man, would have gone into engineering if they didn't derive *some* pleasure from the technical aspects of the work. With respect to interpersonal interaction, collaboration is essential to new product development when up to 30 developers can be working on different parts of the same software system" (ibid, p. 765-766). At the same time, however, the software developers' perceptions were more gendered than their practice, with men stressing how bad they were at people-interaction, and women playing down their enjoyment of tinkering, distancing themselves from the stereotype of the geek. Another aspect of the people vs technology dualism is rooted, Faulkner argues, in organizational practices that value (and pay) managerial work more than software development work: "There is clearly an organizational premium on heterogeneous skills. Developers' celebration of technical competence, and their tendency to play down managerial work, should therefore be understood as an attempt to reassert their worth in an organizational setting which rewards the heterogeneous more than the narrowly specialist" (ibid, 770-771). This went hand in hand with valuing those in software support roles as invisible, or irrelevant to the work.

Faulkner's critique of the predominance of dualisms in software engineering and other engineering fields (social/technical, abstract/concrete, hard/soft) also stresses how gender hierarchies are constituted through such dichotomies, with consequences on the sense of belonging and wellbeing of women. In a more recent ethnography of engineering firms, Faulkner examined gender-inclusive and exclusive dynamics, introducing the concept of 'in/visibility paradox' as a way to capture the experience of women as a minority in the field whereby women

engineers are highly visible as women and invisible as engineers – both within and without the company (Faulkner, 2009). The women's invisibility is determined by their *greater effort to be taken seriously* as real engineers (compared to the men). Their visibility as an underrepresented minority also means that they "tend to get pigeon-holed by their colleagues into certain stereotypically feminine identities – most commonly as (hetero)sexually available or as mother – identities which have nothing to do with the job and can be extremely problematic in various ways" (ibid, p.177). Faulkner's fieldwork revealed both inclusive practices and exclusive dynamics – such as heteronormative and sexualised culture, pressure to conform to certain masculinities, and offensive/sexist humor targeting women.

Similar normative patterns of inclusion/exclusion are also present in computing education environments, as we'll see in the next section.

Normativity and equity in computing education

Research on equity in computing education has examined the ways in which technologists are socialized and educated, analyzing the symbolic and organizational aspects through which hierarchies of values are created and maintained. Margolis and Fisher's research project at Carnegie Mellon highlighted how computer science education is constructed as a male domain through interpersonal interactions and institutional practices (Margolis & Fisher, 2002). They documented how pervasive stereotypes on gender and computing unfolded in a hostile institutional environment, (re)producing normative ways of articulating both computing and gender. Margolis has subsequently examined the intersection of race and computing education in the US – a widely understudied area - exploring how prejudiced beliefs and structural barriers reinforce white privilege, resulting in an educational ecosystem that excludes Latinx and African-American students (Margolis, 2008).

Some US Computer Science institutions have been particularly active in combining research and practical interventions with the goals of broadening participation and creating a more inclusive study environment: such as Carnegie Mellon (Frieze, 2015) and Harvey Mudd (Alvarado & Dodds, 2010). In 2014, 15 Computer Science departments across the US committed to implementing a series of research-based initiatives to increase the participation of racial/ethnic minorities and women through the BRAID programme, co-led by UCLA, Harvey Mudd and AnitaB.org. These interventions, however, have focused mostly on outreach and on modifying introductory CS classes (typically with a breadth-first approach) and less on structural and policy changes, and had no specific focus on disability.

A growing body of research on diversity in computing is now focusing on disability and accessibility, themes that have been neglected for decades in most diversity-related studies on CS education (C. M. Baker et al., 2022; Jain et al., 2020; Wei et al., 2013). This scholarship has identified multiple barriers to equal access in CS graduate and post-graduate education, as well as practical strategies to anticipate the students' multilayered needs.

Social psychology studies on diversity in computing education have highlighted the negative impact of societal stereotypes associated with computer science on minoritized social groups. These studies found that widespread gendered and racialized stereotypes are found both in the media *and* in institutional environments – the average computer scientist is portrayed as a white, male geek, and Computer Science is typically framed as a narrow technical domain associated with little social interaction and with innate brilliance (Cheryan et al., 2009, 2013, 2017). This has been shown to deter historically minoritized groups from choosing CS as education, while it also negatively impacts the well-being and sense of belonging of CS students who do not embody the stereotypes. These studies typically suggest interventions to counter and prevent negative stereotyping in the study environment: "Rather than 'de-geeking' the fields, a more successful approach involves creating inclusive cultures" (Cheryan et al., 2015, p. 6). As such, suggested interventions target organizational cultures at different scales, from media representations (ads) to internal discursive and social practices.

Critical HCI and STS scholars have suggested looking specifically at the *epistemic culture* of CS as a generative site for possible change. Feminist STS research has explored how heteronormative binary understandings of gender are maintained in computing education through practices of 'rendering technical' – students are taught to model and to render reality as a set of technical problems to solve, while encouraged to embrace hegemonic values of entrepreneurship and competition (Breslin, 2018). Resistance to openly discuss white normativity and racism in computer science has been criticized as a factor that perpetuates unequal power relations and creates a hostile environment for racialized students (Rankin & Thomas, 2020). Scholars focusing on equity, accessibility and intersectionality in computer science education have highlighted the discipline's lack of reflexivity and accountability in terms of what and whom technologies are designed for, and have proposed alternative redesigns of the CS curriculum that introduce critical theories and methods with a stronger focus on gender, race, disability and issues of social justice (Breslin & Wadhwa, 2015; Ko et al., 2020; Oleson et al., 2022).

As Riley argues, understanding how power operates and making norms visible are common aspects of social analysis, but in technical disciplines these approaches tend to be relegated to the margins: "It is especially difficult to locate any of these topics in the 'rigorous' technical core courses of the engineering curriculum; they remain at the margins, in the borderlands of the first year, capstone design, or a stray upper level elective" (Riley, 2017, p. 255). 'Rigorous' epistemic practices and tech cultures of overwork often result in exclusionary dynamics for non-normative bodies: "How do the physical demands of all night problem sets and other aspects of 'rigorous' engineering impact students with family responsibilities, students with conditions that make it difficult to stay up all night, students who need to work a second job on top of work study to get through school? Our assumption of a level playing field of meritocracy is deeply flawed and results in systematic exclusion of talent based on race, class, disability, and other characteristics" (ibid, p.256). Understanding and mapping out what is on the margins of CS - identities, bodies, ontologies - can inform positive change at a deeper level but requires clashing with organizational traditions and power relations that have been crystallized over decades.

Sociomaterial configurations of equity

The first part of this chapter explored normativity and hierarchies of values in computing cultures, and highlighted the exclusionary social dynamics they generate. Researching equity in computing is attending to how norms and values get reproduced and how they circulate in institutional spaces (norm-critical analysis). It also involves identifying sites for potential change and experimenting with new practices - this opens up a norm-creative phase in which new norms are created. As Sara Ahmed notes, "Institutions provide a frame in which things happen (or don't happen). To understand how 'what happens' happens, we actually need to narrow (rather than widen) the frame: to think about words, texts, objects, and bodies, to follow them around, to explore what they do and do not do, when they are put into action" (S. Ahmed, 2016, pp. 49–50). To explore these issues, I use the lens of *sociomateriality.*

Sociomaterial assemblages of equity in education

Wanda Orlikowski's concept of sociomateriality highlights how every organizational practice is always entangled with materiality: "a considerable amount of materiality is entailed in every aspect of organizing, from the visible forms — such as bodies, clothes, rooms, desks, chairs, tables, buildings, vehicles, phones, computers, books, documents, pens, and utensils — to the less visible flows — such as data and voice networks, water and sewage infrastructures, electricity, and air systems. Despite such pervasive examples, materiality has been largely

ignored by organizational theory" (Orlikowski, 2007, p. 1436). According to this analytical perspective, the researcher does not approach the field in terms of a human/material dichotomy – focusing primarily on technology, or primarily on people as discrete entitites - but rather looks at the organization as a *sociomaterial assemblage* that is "both emergent and contingent. It temporarily binds together a heterogeneous assembly of distributed agencies"(ibid, p. 1445). When it comes to equity in organizations, slicing the sociomaterial assemblage opens up new ways of tracing exclusionary dynamics, alternative narratives and gaps/opportunities in mechanisms of accountability. The researcher can become a (temporary) active part of the assemblage, too. As we discuss in paper 1 and 2, by noticing how exclusionary norms and values operate in FB groups, student-run spaces, a songbook, or the (in)accessible toilets of our buildings, we engage directly with more than just institutional analysis or critique, and actively reassemble the sociomaterial (see also the list of Interventions).

There are many limits to what can be re-assembled within the organization, due to the systemic nature of discriminatory and exclusionary dynamics. In this regard, the more recent conceptualization of assemblage by anthropologist Anna Tsing is helpful because it adds a more explicit focus on broader sociopolitical aspects that enable and restrain change. Tsing describes assemblages as "open-ended gatherings. They allow us to ask about communal effects without assuming them. They show us potential histories in the making. (…) thinking through assemblages urges us to ask: How do gatherings sometimes become 'happenings'?"(Tsing, 2021, pp. 22–23). Tsing points out that assemblages are shaped by political economy – as such, I see the Gender Equality Plans required by EU funding bodies (discussed in Research Settings) as an example of the entanglement between neoliberal governance, the current landscape of financial support to universities and local organizational practices and understandings. Values and norms are (re)produced at the *unintentional* juncture of multiple and dissonant perspectives, agencies and artifacts (Tsing, 2021). In practice, this perspective allows us to tease out the many layers through which equity is configured in sociomaterial artefacts, data and practices. Assemblages show us possibilities.

New possibilities for equity in computing are always negotiated across multiple scales within the assemblage. The framework of Equity in Education (Unterhalter, 2009) provides a good lens for teasing out some of these scales in ways that can orient strategic change in practice. Unterhalter, a South African educational researcher focusing on race, gender and class inequalities, argues that equity in education operates on three main levels that are closely interconnected: equity

from above, equity from the middle and equity from below. *Equity from above* is the layer of **laws and regulations**, which can also be bigger and smaller than the state level (institutional regulations, diagnostic frameworks, state laws, UN Conventions). *Equity from below* is the layer of participation among equals, it entails the necessary creation of a **fair space for agency, negotiation, and discussion** across different points of view to sustain processes of liberation. *Equity from the middle* "is associated with the movement of ideas, time, money, skill, organization or artefacts that facilitates 'investments' (ibid p.421) the **social arrangements in education that enable change**. The three layers exist in a dynamic relation: a space for critique and dialogue from below inform processes and push for change in new directions, but needs to be supported and sustained by fair regulation and strategic frameworks, organizational practices, artefacts, funds and ideas. This approach highlights the key role of bottom-up initiatives and recognizes that equity in education always occurs through complex cooperative engagements. To address my second research question and explore how *cooperative practices can support change toward more equity in Computer Science* I engage with CSCW literature and critical access theory.

Supporting equity in collaborative systems

CSCW research at the intersection of equity and organizational domains is rich and growing. This scholarship has explored gendered and racialized organizational practices enabling and constraining equity (Ale-Ebrahim et al., 2023; Erete et al., 2021; Turner & Hui, 2023); accessibility in cooperative settings (Das et al., 2019, 2021; Wang & Piper, 2018); community-based and equity-focused work practices (A. A. Ahmed et al., 2021; Rankin & Irish, 2020). Together, these studies indicate that sociotechnical systems can re-enact systems of oppression (in their design, or use, or both) by reducing multifaceted identities to rigid categories. This scholarship also stresses how non-normative bodies must figure out their own workarounds or adaptations - or advocate for change - when interacting with sociotechnical systems that are not designed and/or implemented with their needs in mind. Lastly, these studies stress the importance of centering: 1) values such as **trust and safety** in collaborative systems and practices; 2) the **engagement of historically marginalized social groups** in the design and implementation of technology solutions (in non-tokenistic, non-exploitative ways), and 3) **flexibility** in design and implementation of systems to account for context-specific use.

Equity in higher education and *articulation work*

CSCW research on organizational work practices in education holds great potential for transforming higher education institutions (Wardrip et al., 2013), not least because of the

discipline's commitment to action-oriented research and organizational change (Schmidt & Bannon, 1992). For CSCW and the field's interest in cooperative practices, a focus on the domain of equity and inclusion work in academia would be relevant and generative – both in terms of extending theory and experimenting with new methods. However, there is little CSCW research on equity in higher education institutions, with few exceptions exploring accessibility and the invisible work of dyslexic adults in academia (Wang & Piper, 2022); institutional gatekeeping and collaboration for equal access (Yıldız & Subaşı, 2023) and feminist design interventions challenging gender normativities in computing (Bjørn et al., 2023). These studies stress the disproportioned **articulation work** on behalf of students or staff with disabilities in order to have equal access to technologies/resources, and a pervasive lack of **literacy and infrastructure** around accessibility in academic institutions (Wang & Piper, 2022; Yıldız & Subaşı, 2023). These findings are consistent with previous literature on equity in higher education. When it comes to accessibility, cross-departmental collaboration across campus is typically lacking, requiring complex workarounds by caseworkers and students (Vaccaro & Kimball, 2019). *Articulation work* is a concept first introduced by sociologists to describe the articulation of tasks in cooperative arrangements, highlighting the complexity of multiple stakeholders and division of labor: "Since the plurality of tasks making up their totality, as well as the relations of actors to tasks, are not automatically articulated, actors must do that too, and often in complex ways" (Strauss, 1985, p. 2). These efforts of coordination and integration have been defined as invisible, as Star and Strauss argue: "Articulation work is "work that gets things back 'on track' in the face of the unexpected, and modifies action to accommodate unanticipated contingencies. The important thing about articulation work is that it is invisible to rationalized models of work." (Star, 1991a: 275; Strauss, 1985, 1988; Berg, 1997)."(Star & Strauss, 1999, p. 10). Star and Strauss discuss how situated social norms and values shape understandings of what counts as visible and valued work, and what gets ignored and/or devalued – on a general level, classic examples of the latter are domestic care work, nurse and secretary work, caregiving tasks performed by individuals at home, on-call support tasks, to the extremes of slavery (Star & Strauss, 1999). In CSCW, articulation work describes "the cooperative work to make cooperative work work" (Schmidt, 2011, p. 184). Understanding invisible work and articulation work (and their contingencies) is essential to better develop and implement technologies and organizational practices that support complex and distributed cooperative activities – especially when the goal is supporting *equity-focused* collaborative interactions. As we discuss in paper 4, an overlooked form of articulation work in CSCW studies is *access labor*, which includes the practices of negotiating or seeking equitable access to technologies, services and organizational resources in

complex organizations. When people interact with sociotechnical systems that present barriers to accessibility, they put in extra work and time to get what they need, and sometimes this also includes educating organizational actors and advocating on behalf of others. Access labor is increasingly in focus in CSCW/HCI research on accessibility (Jain et al., 2020; Shinohara et al., 2020; Wang & Piper, 2018, 2022), particularly in studies exploring situated work practices. *Access labor* is a concept typically used in the context of disability and accessibility – but in this thesis I expand its meaning to also include the efforts required of any minoritized groups to negotiate equal access to safe and welcoming environments – pushing against barriers and everyday processes of exclusion. Access "organizes socio-political relations between people in social space" (Titchkosky, 2011, p. ix). Understanding and mapping this invisible articulation work is crucial to developing equity-focused collaborative practices and systems.

CSCW and diversity in organizations

It is worth mentioning that disability has been very undertheorized in the context of CSCW (as in many other disciplines), and it has been practically absent in most CSCW conceptualizations of collaborative engagements, even though individuals with cognitive and physical disabilities are present in all work domains – and although accessibility is always cooperative work (most often, invisible work). Interestingly, the domains that have historically been the main target of CSCW studies are the ones with the lowest disability presence – according to recent US data from the CDC, the distribution of persons with disabilities in business and financial operations is 11,3 %; among health-care practitioners and technicians is 11,1%; in engineering is 11% - whereas among food preparation and serving professions is almost 20%, and among personal care and service professional is 19,4% (Shockey et al., 2023). According to this report, almost 15% of the currently employed US population has a disability, the most common category being cognitive disabilities (which, as we mention in paper 4, are among the least under-researched types of disabilities in HCI/accessibility). Given the pervasiveness of barriers faced by people with disabilities in cooperative engagements, it is imperative for CSCW to have a stronger focus on disability. Embodied cognitive and physical differences are more likely to be stigmatized or made invisible (and therefore might be easier to be overlooked by researchers) but can influence people's everyday interaction with sociotechnical systems in ways that lead to measurable inequitable outcomes.

However, considerations of diversity/difference have always been fundamental to CSCW research, since designing systems to support collaboration means considering how social and

material relations shape cooperative work. As such, CSCW research considers factors like 1) *organizational norms* - see for example the MoCA framework and its emphasis on multi-dimensional scales of difference in coordinated action (Lee & Paine, 2015); 2) *beliefs* – such as different 'webs of significance' in which actors are situated, causing extra interpretive articulation work within common information spaces (Bossen, 2002; Reddy et al., 2002); 3) *status/power difference*, for instance in the context of invisible and/or gendered work (Nielsen et al., 2023; Wagner, 1993) and in classification systems (Bjørn & Balka, 2007; Blackwell et al., 2017). The invisible articulation work of DEI and accessibility taking place within the university is strictly connected with current (and missing) classification systems.

Cooperative DEI practices and the role of classification systems

Studies of equity and inclusion in higher education show that there is often a lack of shared definitions and agreement about the breadth, depth and scope of DEI work within institutions (S. Ahmed, 2012, 2017). This might result in overlooking certain areas - as such, disability is often considered 'a different diversity', relegated to the margins of discussions and institutional practices of inclusion (Kim & Aquino, 2017). We (re)produce meaning and (re)configure social relations through categories of exclusion/inclusion: what is classified can be de-classified, creating new norms and de-stigmatizing identities, as with the removal of homosexuality as a mental disorder from the Diagnostic and Statistical Manual of Mental Disorder (DSM) in 1973, or Denmark's decision to remove trans people's classification as 'mentally ill'. CSCW and HCI research have explored how systems of classifications are enacted in sociotechnical artifacts and practices, discussing the constraining power of categorization systems as social ordering devices (Suchman, 1993). A large body of CSCW scholarship draws on Star & Bowker's classification theories to analyze how power differentials shape sociotechnical infrastructures and their classification systems (Star & Bowker, 2007), emphasizing how categories are shaped by institutional norms and situated practices (Bjørn & Balka, 2007). Sociotechnical classification systems are imperfect entities – they present several limitations when it comes to accounting for non-dominant or non-normative experiences and bodies. Sometimes non-normative categories can be covert or unlabeled – they are so-called residual categories, not formally represented within a classification system (Star & Bowker, 2007). One example examined by Katta Spiel is the absence of options for registering non-binary gender in web interfaces connected to databases, which leads to the misgendering of non-normative users (Spiel, 2021b). Indeed, non-binary gender is a residual category in all IT systems and many spaces (for instance, toilets) at

the University of Copenhagen, and changing these in practice has highlighted areas of tensions and regulatory misunderstandings (see Methods for more details).
Stigmatization and othering are deeply linked with ethnic categorizations: race as a master category (Omi & Winant, 2014) has historically served to shape the distinction between the norm and 'the other'. The ways different organizations collect diversity data in relation to race/ethnicity is shaped by socio-political concerns and organizational norms: Danish universities do not ask for ethnic self-identification, whereas UK institutions do. Dutch academic publisher Elsevier created a classification system in which authors must select all geographic areas from which their "family's ancestors first originated"[9] – whereas, until recently, IBM listed 'yellow' and 'mulatto' listed on an online recruitment page[10]. Classification processes in sociotechnical systems can be empowering, particularly when the design is user-driven. One example is a study of a digital platform for and by targets of online harassment, documenting how labelling abusive behavior as 'online harassment' is critical for making social norms more legible and validating harassment experience, (Blackwell et al., 2017). In paper 1 we discuss how student counsellors in one faculty changed their practices of *not* labelling nor archiving complaints related to sexual harassment/harassments of students – although official institutional guidelines or transparent reports on harassment are still missing.

Classification systems in IT systems are often linked with normative ways of understanding networks of care and their relational units as well. CSCW research has explored the gap between relational aspects of care work and sociotechnical care infrastructures in a variety of domains (Fitzpatrick & Ellingsen, 2013; Ismail et al., 2018; Park et al., 2019). For example, Bjørn et al. have discussed the heteronormative assumptions underlying the first iteration of the Danish pediatric dental appointment IT system, in which the mother of the child is by default deemed responsible for the appointments (Bjørn et al., 2023). The design lacks flexibility and does not match the wide range of household configurations. Similarly, in paper 4 we explore how third-

[9] See this Elsevier report on Gender, Race and Ethnicity Data collection: https://researcheracademy.elsevier.com/uploads/202207/Elsevier%20Diversity%20Data%20Editor%20Webinar_July%202022.pdf (accessed Dec 2, 2023).

[10] See the CBS news article https://www.cbsnews.com/news/ibm-is-sorry-for-asking-job-seekers-if-they-are-yellow-or-mulatto/ (accessed Dec 2, 2023).

party disability service providers configure their systems in ways that ignore, therefore disrupt, existing care networks, creating accessibility breakdowns.

Troubling the 'normate template' – towards intersectional DEI approaches to equity

These processes of distilling the variety and multiplicity of human bodies and social relations in standardized, predictive and imperfect categories and average 'users' have been conceptualized as the 'normate template' (Hamraie, 2017). With the concept of 'normate template', Hamraie indicates the historical process of designing the world with *normate inhabitants* in mind. Hamraie draws here on the concept of 'normate', coined by disability scholar Rosemarie Garland-Thomson to indicate "the figure outlined by the array of deviant others whose marked bodies shore up the normate's boundaries (…) if one attempts to define the normate position by peeling away the marked traits within the social order at this historical moment, what emerges is a very narrowly defined profile that describes only a minority of actual people" (Garland-Thomson, 2007, p. 8). If the normate only represents a small group of people, Garland-Thomson argues that disability as an identity category flattens intragroup difference (much like all socially constructed identity categories) conflating a wide array of bodies under one label which does not account for the dynamic, contingent nature of many impairments and conditions. The international symbol of access (ISA), for instance, consists of a blue and white square representing a stylized person in a wheelchair, but it is also used to indicate accessibility and disability in relation to people who do not use wheelchairs. As we discuss in paper 4, accessibility at the University of Copenhagen is also understood and referred to largely in relation with physical disabilities (as in barrier-free facilities and access for wheelchairs), and accessibility information is generally not available on the university website (see Methods for more details). Communication about how to reach our facilities has been developed with the *normate* in mind[11], a good example of what Jay Dolmage has termed academic ableism (Dolmage, 2017), a taken-for-granted orientation that privileges ability over disability in social structures and the built environment in universities.

Figure 4: The international symbol of access.

[11] Danish legislation does not mandate providing accessibility information, not even for public institutions.

Although ‘official’ and top-down DEI work at my institution has so far privileged a focus on gender equality (see Research Settings), my PhD project has a focus on equity from an intersectional perspective. Intersectionality originated in Black feminism, critical legal studies and race studies in the 1980s as a “heuristic term to focus attention on the vexed dynamics of difference and the solidarities of sameness in the context of antidiscrimination and social movement politics. It exposed how single-axis thinking undermines legal thinking, disciplinary knowledge production, and struggles for social justice” (Cho et al., 2013, p. 787). What makes an analysis intersectional is “conceiving of categories not as distinct but as always permeated by other categories, fluid and changing, always in the process of creating and being created by dynamics of power” (Cho et al., 2013, p. 795). The case of the ‘porn toilet’ (paper 1) shows which groups of students are more vulnerable to inadequate institutional interventions that fail to create an inclusive and accessible environment for all. As an analytical tool, intersectionality is increasingly applied in various disciplines, including HCI and CSCW, allowing to better capture situated dynamics of power. It allows us to analytically focus on the intersection of different aspects of people’s embodied identities in regard to HCI systems (Schlesinger et al., 2017), but can also be used as a tool for social change in CS research communities (Wisniewski et al., 2018), helping us identify and reflect upon the normative tendencies shaping our own work (Spiel, 2021a).

PART THREE

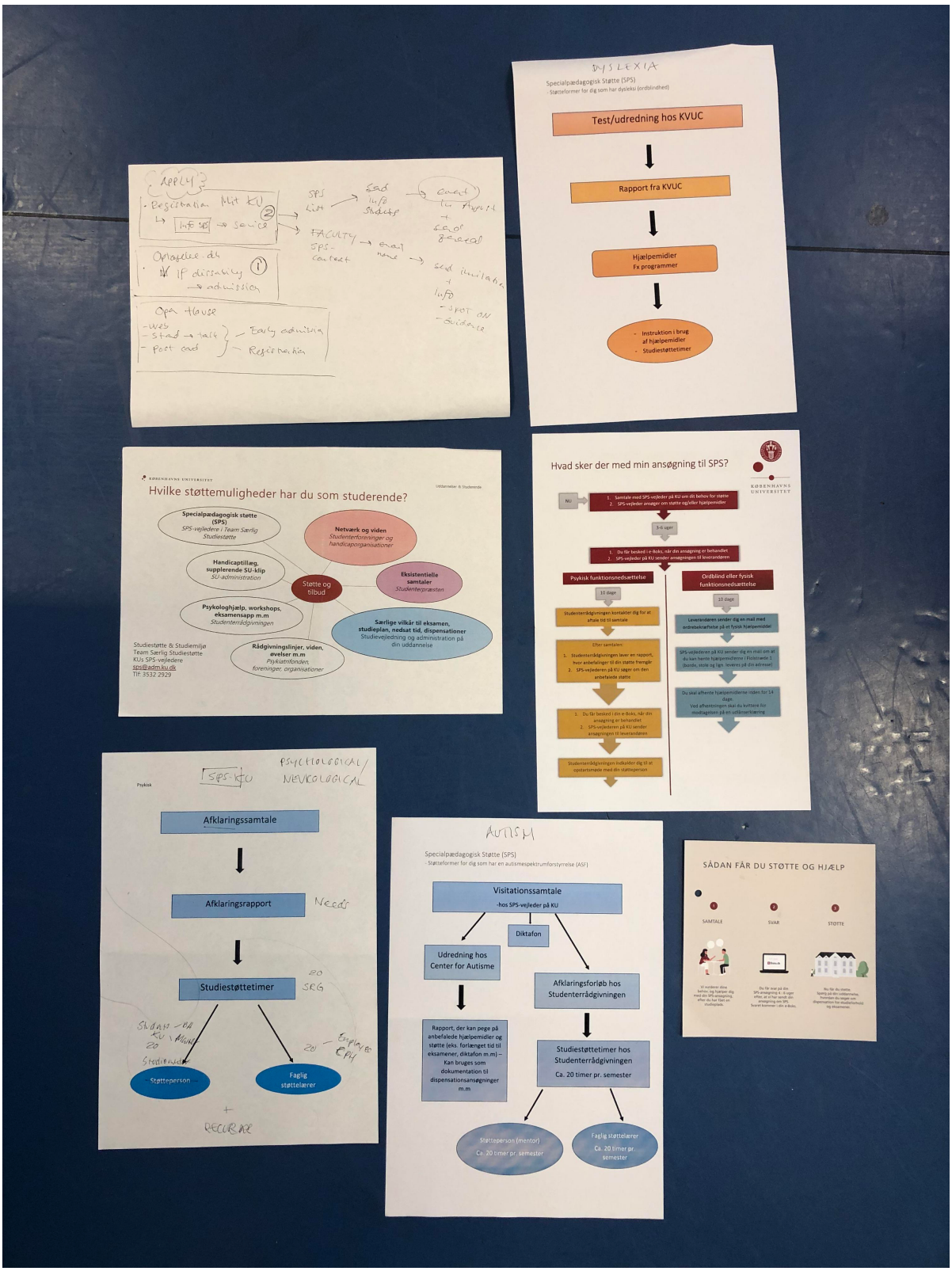

Figure 5: Institutional leaflets on the mechanisms and timelines of the SPS system, with sketches and notes by a disability officer at UCPH.

METHODS

A norm-critical and norm-creative ethnographic inquiry

In this chapter, I give an overview of my methods. To address the research questions I combined norm-critical and norm-creative inquiry. The **norm-critical mode** of my inquiry paid particular attention to the norms and power relations that lead to inequitable practices and socio-technical barriers to inclusivity and accessibility. At its most basic, this research made things visible for the first time to a variety of organizational and external actors. As Ahmed notes: "making sexism and racism tangible is also a way of making them appear outside of oneself, as something that can be spoken of and addressed by and with others". This typically brought up the question of accountability (paper 2), opening up for dialogue and new changes, or highlighting and documenting unresolved institutional blockages and gaps in mechanisms of accountability. My research also had an action-oriented and **norm-creative mode**, challenging current norms by co-creating *collective actions* and artifacts to support equity in practice.
In paper 1 I describe how, as part of my engagement with my department, my norm-critical/norm-creative approach took the form of an 'ongoing formative critique'. My goal here is not to repeat what we wrote in paper 1, but to situate my methodology within different strands of action-oriented research in design, computer science and anthropology.

The conceptualization of norm-critical/norm-creative approaches for social change originates in Scandinavian design research. In their paper *Tactics for Norm-Creative Innovation,* Wikberg-Nilsson and Jahnke argue that *being norm-critical* (identifying and challenging social norms leading to inequalities) is a necessary step for any designer who wants to be *norm-creative* (which involves creating inclusive design solutions by counteracting exclusionary norms) – together, these two steps form what they conceptualize as *norm-creative innovation* (Nilsson & Jahnke, 2018). The authors outline a series of norm-creative tactics to explore the design space and suggest novel ways of action for designers, more or less radical. They emphasize that norm-creative tactics are not a ground-breaking new approach to designing – but rather synthesize or are tweaked from a variety of pre-existing perspectives from participatory design/codesign (Buchenau & Suri, 2000; Ehn, 1988), critical design (Dunne & Raby, 2013), inclusive design (Persson et al., 2015), universal design (Frandsen et al., 2023) and so on. Norm creative innovation originated in collaboration with the Swedish research and innovation agency Vinnova, and as such included the testing of tactics and processes in firms. The goal was to

create more awareness around inclusivity and develop new solutions. In my practice, I did not aim to design solutions. Instead, I co-created actions and artifacts to gain new knowledge, raise institutional awareness and support change.

My methodological approach is eclectic and inspired by research through design (Zimmerman et al., 2007) and interventionist feminist HCI/CSCW research (Bardzell, 2010; Bjørn & Boulus-Rødje, 2015). These approaches share an orientation towards making artifacts and creating interventions as a source of inquiry. In addition, feminist approaches stress a stance toward social and institutional critique, social empowerment and collaborative action to challenge systemic inequality. I am also inspired by the Italian tradition of design for social innovation pioneered by Manzini at the Politecnico of Milan (Manzini, 2015). Manzini's practice is particularly relevant, as it is norm-critical and typically situated within neoliberal, new public management ecosystems – which share many commonalities with the neo-liberal Danish university system we analyze in this PhD thesis. Manzini emphasizes the strategy of introducing *discontinuities* with what is locally considered a 'normal' way of doing things, and doing so in a process of *infrastructuring* (Karasti, 2014) new collaborations and new practices. Discontinuities create trouble because they break old traditions. No action-oriented research on equity (especially in higher education) is possible without creating discontinuities. Action-oriented researchers always aim at "intentional disturbance, informed by collective knowledge fueling action" (Herr & Anderson, 2015, p. 159) as I document in the last section of this chapter (see Collective Actions).

Throughout the PhD project I used a combination of ethnographic methods including in-depth semi-structured interviews; document and artifact analysis; participant observation and observant participation, as you can read in detail in the papers. Ethnographic studies have a long tradition in CSCW (Blomberg et al., 2017; Blomberg & Karasti, 2013; Randall et al., 2007) where special attention is placed on understanding the sociotechnical organization of cooperative activities. In HCI research, ethnographic work has the potential to provide models and new ways of thinking, pushing beyond mere 'implications for design', as Dourish argues: "Ethnography has a critical role to play in interactive system design, but this may be as much in shaping research (or corporate) strategy as in uncovering the constraints or opportunities faced in particular design exercise" (Dourish, 2006, p. 549). In the first paper published during this PhD (paper 2 - on humor) we adopted a multi-sited ethnographic approach (Marcus, 1995) to highlight how humor both (re)produces and queers stereotyped narratives in computing. Ethnography was valuable in showing the constraints and limitations of organizational data-driven efforts towards 'diversity in

computing', and highlighted the potential of examining sociomaterial practices in order to tackle deeper issues. This study brought up institutional discussions on power relations, accountability and student wellbeing which were sometimes perceived as 'controversial' by some employees. That dialogue marked the beginning of a fruitful collaboration with my colleagues at the department.

My approach to ethnographic research is both dialogic and transformative: the institutional critique went hand in hand with a process of diffractive change (see also paper 1).

Lastly, my methods have been informed by anthropological approaches such as experimental collaboration through *fieldwork devices* (Estalella & Criado, 2018). Estalella and Criado argue that doing research in fields populated by scientists and public servants (epistemic partners) can spur new engagements and social arrangements (fieldwork devices) such as co-organized events, new circulation of data, book launches. These devices are new experimental ways to construct joint anthropological *problematizations* in the field (rather than focusing on *solving* problems) which enrich knowledge production. By co-creating new institutional initiatives such as a Code of Conduct, for instance, I gained a better understanding of how different actors took on the concept of accountability. Fieldwork devices are mobile. The CoC has 'traveled' beyond the boundaries of the computer science department. Upon request, we have shared the document with others interested in implementing equity-focused projects in multiple fields, from CS professors at TU WIEN to norm-critical diversity consultancies based in Copenhagen. With that, we've shared our cooperative problematizations as well, not just a list of values and accepted behaviors – and provided a foundation (or simply an opening) to experiment with discontinuing norms elsewhere.

Field encounters and relationships

The point of departure

Before my PhD I gained four years of professional experience in DEI by working as a diversity officer at ITU. I was tasked with understanding the main factors behind the low participation of women in ITU's Software Development education. In my first year on the job I combined qualitative research with desk research to produce an executive report for ITU management. Part of the findings (on recruitment and retention) were published and presented at the ICSE conference in their education and training track (Borsotti, 2018). The ITU report was the basis for a series of positive institutional changes. But being a diversity officer meant experiencing a

certain level of organizational churning, and a regular reshuffling of my tasks – particularly in correspondence to organizational restructuring in management. Upon returning from maternity leave, I was moved from the Learning Support Unit to HR and asked to relinquish the tasks related to students. These tasks were then divided between the Communication & Marketing Unit and the administrative Student Support Unit (SAP). Over time I came to think of my work as a constant reconfiguring of goals and activities – threading through different agendas and building bridges across people and functional units. Upon my move to HR, I felt stuck. I missed being connected with teachers, students and the other learning consultants, close to the sites where bottom-up change and new ideas were most likely to sprout. Historically, significant systemic and policy changes in DEI and accessibility in higher education have mostly been pushed by minority staff and students working towards more equitable work and study conditions (S. Ahmed, 2017; Hamraie, 2017). This is when I made the switch to research. However, I did not close the door on my professional experience and background – they have shaped my action-oriented research approach and the kind of research questions I developed.

I met my PhD advisor Pernille Bjørn shortly before my transfer to HR, when we both attended a seminar on Software Development D&I in the US. We both shared a passion for DEI work and research in computing, and felt that together we could design a research project with a clear focus on institutional change and inclusivity. That is how this project was created. This PhD became part of - and funded through - the FemTech research initiative, established at DIKU by Pernille as a "sociotechnical infrastructure that collects and interlinks several projects and activities supporting the long-term change agenda for gender equity in computer science" (Bjørn et al., 2023, p. 12). All FemTech projects – including this one - are action-oriented, and include the creation of critical design artifacts (Bjørn & Menendez-Blanco, 2019; Menendez-Blanco et al., 2018) challenging normative understandings of computing.

Beyond 'data collection': *ongoing formative critique*

In line with the FemTech programme, my research aimed to make normativities in computing visible and took an interventionist approach. The action-oriented, ethnographic approach used throughout my research is conceptualized in paper 1 as *ongoing formative critique*, a form of engagement that includes taking a critical position relative to dominant practices while also supporting and creating local forms of change. In paper 1, anthropologist Samantha Breslin and I discuss three dimensions of this practice: noticing, documenting and negotiating. The practice of noticing institutional dynamics with 'classic' anthropological methods such as interviews,

observations, field-note taking, is intertwined with documenting – in the form of academic publications, or with internal and external presentations or more experimental approaches such as games (see also DOREEN in paper 3). Noticing and documenting overlapped recursively with negotiating – we negotiated our expertise and positionality in a constant process of building institutional awareness.

During my research I collaborated with students, teachers, disability officers, government clerks, managers at department and faculty level and researchers in a collaborative, diffractive process (see paper 1). The feminist optical metaphor of *diffraction* is often used to emphasize the relational aspect of knowing (Barad, 2007; D. J. Haraway, 2018) – it stresses a process of reading 'through one another' (Barad, 2007, p. 273). Ongoing formative critique generated *diffractive change* – a non-linear form of impact that expands beyond discrete interventions and often connected areas of concern that have been traditionally seen as separate. The process of noticing and documenting sexist narratives in students' spaces, for instance, diffracted into raising questions of accessibility, was followed by dialogue and negotiation for change at the Faculty level, and led to an accessibility walk on our campus with students and staff representatives. The impact of ongoing formative critique cannot be measured quantitatively - we use 'formative' as a reference to formative assessment in education (versus summative) with its ongoing, multistakeholder feedback process (Scriven, 1966). The impact of this work was instead seen in changes of social, discursive and spatial practices.

My role as a researcher: insider/outsider

As Blomberg and Karasti argue, "Field sites as unbounded spaces of possibilities are continuously 'carved out' by the ethnographer in relation to specific resources, situations, and opportunities in the settings" (Blomberg & Karasti, 2013, p. 389). To better illuminate how I co-constructed my research field site – and the constraints and opportunities of these arrangements, I will give an account of my role as a researcher. Throughout my PhD, I have worked in the dual role of PhD student and Diversity Chair for my department – which allowed me to combine norm-critical inquiry and norm-creative change.

Thanks to my dual role, I had the vantage point of studying situated practices in one specific department – facilitating access and rapport in a relatively short time. At the same time, this allowed me to 'slice up' the complex assemblage of equity in computing education – interrogating dynamics and practices at various levels, in a multi-sited journey.

Positioning oneself as an *observant participant* is not uncommon in organizational studies (Moeran, 2009) as it allows the fieldworker to move into the 'backstage' of an organization (ibid) gaining a deeper understanding of people and institutional work processes. The observant participator is "more likely to enact a preexisting role in the field" (Seim, 2021, p. 3). But in my case, the Diversity Chair role was a brand new one. There were no other Diversity Chairs at UCPH either - I was navigating uncharted territory. According to the Fieldwork Agreement I co-signed with DIKU, my expected role as Chair was mainly as an advisor in the DEI area, and co-creator of interventions. The fieldwork agreement also included my ethical obligations to the people I studied and the people I worked with (categories that often overlapped), following the American Anthropological Association (AAA) code of ethics and in compliance with the Danish Code of Conduct for Research Integrity and UCPH's Code of Conduct for Responsible Research.

Processes of *incorporation* in 'the field' are defined as how "people in a setting define the researcher and accord her or him a particular role or social place in that setting" (Warren & Karner, 2010, p. 85). It took a few months to become attuned to my role and to the colleagues I would end up working closely with. The creation of the committee Inclusive DIKU, of which I was a part, was instrumental in kickstarting a closer connection with the department administrators and managers working with – or interested in – issues of student inclusion (read more under Collective Action at the end of the chapter). Researching – and critiquing - my institution while being employed within it presented several challenges, as I discuss in paper 1. It became easier to navigate my role as an institutional critic when I became a more active collaborator in making change. Spending the last 8 months of my PhD visiting other research groups (while still engaging in meetings at my department) also helped in achieve more reflective distance. I visited Dr. Katta Spiel at TU WIEN (June-July 2023) and Dr. Samantha Breslin at UCPH Anthropology Department from September 2023 to January 2024.

Relationships with research participants

One of my goals was to understand barriers and opportunities to equity from the inside, as close as possible to relevant organizational actors at DIKU. But my research also included other computer science institutions (see paper 4), and I have interacted with stakeholders at Faculty level and the university's central administration. The people I built a closer relationship with were administrators, teachers and managers at DIKU. Some of them became regular collaborators on a few projects (see Collective Actions). The disability officers I interviewed during my study on accessibility maintained an ongoing dialogue with me and created new

channels of communication with one of the DIKU programming teachers I interviewed in the same project. I interacted with students mostly during interviews, ten sessions of participant observation during classes and exercises, informal conversation, supervision, and collaboration in Collective Actions. I disseminated my research internally and externally (not including academic venues) through presentations and discussions with: 1) administrators at the department level during regular meetings; 2) management, thanks to regular dialogue and meetings; 3) Faculty management, thanks to a workshop (see paper 1); 4) students and staff at DIKU, during a research presentation open to all; 4) students in other universities (TU Berlin, ITU) thanks to invited presentations in their courses; 5) ITU disability officers and teachers, thanks to an invited presentation.

Trust, emotional wellbeing, and creating a 'safe space'

Doing equity-focused research often means engaging in contested dialogues and discussing topics that are stigmatized or distressing. Creating a safe space for both discussion and collaboration – for myself and those participating in my project - has been one of my main concerns from the beginning. Researchers in participatory decolonial design have conceptualized 'safe space' as a "consciously developed social environment for thoughts, situated actions, and mutual learning that allows participants both to engage in dialogues about their everyday experience, tensions, and contested pasts, and consequently to imagine and co-create alternative and plural futures" (Kambunga et al., 2023, p. 2). This work prompts researchers to 1) better reflect on their own gaze and understandings, particularly in terms of power relations and historical processes of marginalization and 2) nourish an open space of dialogue and cooperation. This project was not just 'mine', it was also a 'DIKU project'.

Action-oriented research is based on mutual learning and collaboration – and supporting an atmosphere of trust with the people I worked with has been a crucial concern. As an example, an administrator told me of their discomfort discussing issues related to student sexual harassment because of a negative experience with a researcher investigating these topics, which resulted in a lack of trust. I respected my colleague's choice not to collaborate. Others were justifiably uncomfortable at the idea that I was 'studying them', and my constant note-taking during Inclusive DIKU committee meetings – where I played an active role – made my administrative colleagues feel nervous. I agreed that I would not report verbatim quotes in research articles unless they were from an interview where consent was given. The fieldwork agreement, and ongoing dialogue with my colleagues, have been a key instrument for negotiating relationships and collaborations over time.

Ongoing formative critique has an impact on structural institutional change, on the people we worked with, but also on ourselves as researchers. My research was bound up with emotions – both negative and positive. Although emotions play an important role in how ethnographers engage with their field and build relationships, emotional labor has been largely overlooked in anthropology – which is also reflected in inadequate methods courses and academic support structures (Lo Bosco, 2021). The emotional well-being of researchers hasn't just received little attention in the social sciences, but also in human-centered computer science fields. Even though research in CSCW and HCI increasingly focuses on emotionally demanding contexts like structural oppression, illness, harassment and violence (Chen et al., 2022; Rankin et al., 2021; To et al., 2020), we are still far from seeing appropriate and systematic institutional support mechanisms and awareness for emotionally demanding research fields (Feuston et al., 2022). Recent work in HCI has proposed considerations for practice when conducting research in contexts that make the emotional well-being of researchers vulnerable – which include institutional mechanisms such as debriefing and counseling (Moncur, 2013). In paper 1, we highlight further suggestions to support researchers engaged in processes of institutional change.

Interviewing students and staff on subjects related to systemic oppression meant discussing harassment, ableism and other forms of discrimination and harm they experienced, which could cause distress. Talking to a student who shared her experience of sexual harassment for instance provoked a strong reaction in me: anger at not being able to help, pain at remembering a similar personal experience (as well as the experience of some colleagues and friends throughout the years). Shortly after the interview, I decided to abandon my idea for a study on institutional data practices around sexual harassment. Ahmed has highlighted the role played by emotions in feminist work: anger, pain but also positive ones such as wonder, love, joy and hope: "The hope that guides every moment of refusal and that structures the desire for change with the trembling that comes from an opening up of the future, as an opening up of what is possible. Such emotional journeys are bound up with politicisation, in a way that reanimates the relation between the subject and a collective." (S. Ahmed, 2014, p. 171). Organizational change is necessarily a cooperative process, and as such I also shared many joyful moments with my advisor, administrative colleagues, students and teachers when we were able to create meaningful change together. Sometimes, my findings worked as provocations and generated collective anger and surprise, which motivated practical change, as I will touch upon in the final part of this chapter.

Researching equity in computing while doing service work as Diversity Chair presents further challenges related to emotional well-being. DEI is a relatively new professional area, and there is little research on the emotional and psychological impact of this type of work. Recent studies suggest that DEI professionals experience unique challenges that lead to higher levels of exhaustion, particularly in association with experiences of tokenism, role ambiguity and lack of top management support (Pemberton & Kisamore, 2023). The ways organizations handle DEI, strategically and in practice, can greatly impact the emotional labor of DEI professionals (Weeks et al., 2023). Taking a critical position toward norms and practices at my department involved navigating the emotional labor and frustrations involved with this type of work and finding support in counseling and academic networks of researchers working with related topics. Systems of support – within and without the organization - are crucial in fostering a sense of belonging, emotional well-being but also academic growth and career and dissemination opportunities. These are even more relevant for researchers with minoritized identities and academic backgrounds in their field.

Navigating knowledge hierarchies in computing

Researchers participate in their institutions differently. Feminist standpoint theory argues that "ideas matter in systems of power" (Collins, 1997, p. 381) - our social position and the social relations of science shape our practice of knowledge production and our experience (Harding, 1986). As we discussed in paper 1, doing interdisciplinary research in computer science and engineering means navigating sociocultural power differentials as well as different epistemic practices. Interdisciplinary work is common in HCI and CSCW, with researchers historically originating from diverse academic backgrounds in social sciences or humanities – from Lucy Suchman to Charlotte Lee. However, these disciplines are situated within a broader socioeconomic context that gives a higher status to engineering/computer science over social sciences and humanities (Dourish, 2006; Riley, 2017). As a PhD fellow in CS with a social science/humanities background I was both an insider and outsider: I had the epistemic privilege derived from being in an academic field with high status, but my background and research interests placed me in a somewhat decentered position at the margins of the discipline.
I encountered and noticed some tensions regarding hierarchies of knowledge in my department, which at times affected my sense of belonging. My background is a mix of humanities and social sciences: I hold an interdisciplinary BA in Literature (which included courses in anthropology, linguistics, sociology of language, Queer and Indigenous studies), and an MS in Anthropology.

Some colleagues encouraged me to emphasize my double identity as a computer scientist/anthropologist, stressing it was a strength, while others warned me that doing so could prevent me from a successful career in computer science. In interdisciplinary fields there are often conflicting assumptions about relevant epistemic and methodological approaches. There have been comments undervaluing qualitative research and suggestions that gender-related studies receive preferential treatment at conferences for political reasons. These tensions are partly due to researchers' unfamiliarity with epistemological and methodological approaches that differ from those they were trained in.

Collective actions and tactics for institutional change

Feminist research is about integrating "knowledge and responsible action, with a mandate for both individual and social change" (Bardzell & Bardzell, 2011, p. 765). As such, this project has generated many *collective actions* – equity-focused acts of institutional change realized together with other people. All these actions have been a collective effort. Not all of the changes were interventions 'designed' by me. In some of these cases, employees or students (or both) came up with new ideas and I supported the project. In paper 1 I discuss the term 'intervention' - which indicates an effort to create change and is commonly used in both feminist research and design – in contrast with emic understandings of change formulated as 'projects' among administrative staff at DIKU, projects which would have various owners or responsible officers. With the term *collective actions* I emphasize the emerging, collaborative and empowering nature of all these interventions/projects. These different forms of institutional changes demonstrate the non-linear and diffractive impact of ongoing formative critique.

Mobilizing shifts in organizational awareness and creating practical change was made possible through various tactics: **recoding rules, mobilizing and facilitating collaboration**, **non-compliance, official complaint, play and accessibility walks.** Each of these tactics aimed at making normativity visible, raising awareness on equity and discrimination issues and building alternatives to organizational processes and dynamics.

In the next and final section of this chapter, I will present each tactic and provide examples of the collective actions that have been generated in the past three years, as part of this project.

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CODE OF CONDUCT

EN Guide for DIKU students and staff

RECODING RULES AS A TACTIC

With the tactic of *recoding rules,* I simply refer to reorganizing regulations and norms into more accessible and reader-friendly forms. Recoding rules help foster equity-focused institutional change. Clarifying norms, sanctions and organizational responsibilities can help prevent and address harassment and discrimination, as it makes institutional grievance procedures and pathways more visible (Council of Europe, 2020). This is especially important to protect the rights of historically marginalized groups and individuals positioned within unfavorable power dynamics in the academy (such as students, staff on temporary contract, sub-contractors), who are more likely to experience exclusionary behavior and discrimination (Bondestam & Lundqvist, 2020; Hill et al., 2020; Marin-Spiotta et al., 2023).

Collective action: DIKU Code of Conduct

One example of collective action using the tactic of recoding rules is the creation of the DIKU Code of Conduct, an initiative I proposed to DIKU management at the very beginning of my PhD. The University of Copenhagen did not have[12] an official CoC outlining values and norms for students and staff, but rather a fragmented series of documents (mostly written in legalese) dispersed throughout the institutional intranet and addressing offensive behavior or interaction with buildings. My intention was to better clarify responsibilities and multiple pathways for reporting discriminatory behavior, as well as clarify shared values.

I drafted the new CoC collating existing UCPH regulations from different documents, and used the Contributor Covenant CoC template as a guide. The new CoC was discussed and approved by many organizational stakeholders, including HR. The process lasted several months.

Some of the elements revealed contentious. An officer from HR for instance originally suggested not to directly mention rape, as it was in my first draft. Upon discussion, we decided to keep all the information about rape and sexual assault (which also included contact info for the police and local public facilities to help survivors of sexual assault). The process of creating a CoC involved dealing with gaps and lack of clarity in terms of sanctions, responsibilities and grievance procedures. It was decided to give the document a colorful graphic layout, to make it stand out.

[12] Still doesn't. The CoC we are discussing here is only used at DIKU.

The most serious instances of discrimination or violence (racism or rape for instance) were highlighted in a red box to give them even more visibility (see below).

We strive to have a respectful, inclusive and diverse environment, and encourage open and critical academic discussion.

The purpose of this code of conduct is to outline the main norms and proper conduct for staff and students in our Department, and clearly communicate existing regulations, protocols and pathways for reporting offensive behavior at DIKU, in compliance with official guidelines by the University of Copenhagen.

Scope
This code of conduct applies to staff and students. It concerns all activities taking place at our facilities and digital learning spaces, as well as to any DIKU related activities that might take place elsewhere such as conferences, Study Start trips, work trips and study trips.

This code of conduct also applies when an individual is officially representing DIKU in public spaces. Examples include using an official DIKU e-mail address, posting via an official DIKU social media account, or acting as an appointed representative at an online or offline event. Guidelines for Responsible Conduct of Research at UCPH are out of the scope of this document, and can be found here.

CODE OF CONDUCT 3

We strive to create a welcoming and respectful environment

A key value for the University of Copenhagen is to encourage an open and critical academic discussion. Academic freedom does however not exempt staff and students from behaving properly and communicating constructively, also in situations of disagreement.

OPEN & ACCOMMODATING
Being open and respectful of differing opinions, viewpoints, and experiences

INCLUSIVE
Focusing on what is best not just for us as individuals, but for the overall community

CONSTRUCTIVE
Giving and accepting constructive feedback

RESPONSIBLE
Accepting responsibility and apologizing to those affected by our mistakes, and learning from the experience

RESPECTFUL
Respecting DIKU's facilities by following the current regulations of the Faculty of Science and DIKU

Examples of unacceptable behaviour

- Offensive behavior such as sexual harassment, which include: unwanted touching, unwanted requests for sexual contact, obscene jokes and comments.
- Offensive behavior such as bullying, which include: being ridiculed or yelled at, slander, unfair denigrations of students and employees' performances and skills, unfair removal of responsibility for tasks.
- Offensive behavior such as denigration on the grounds of race, religion or faith, political views, sexual orientation, gender, age, disability, national, social or ethnic origin.
- The unnecessary use of sexualized imagery or language in classroom settings and in student activities such as orientation weeks' (including Study Start trips).

UCPH guidelines
More information about UCPH guidelines on offensive behavior can be found here.

CODE OF CONDUCT 5

Reporting pathways for students

STUDENT SERVICES
Contact the Student Services. Weekday 9-12.30 (closed Wednesday): (+45) 35 33 35 33 or studenterservice@science.ku.dk.

Your enquiry will be handled confidentially (unless the legislation stipulates that information should be disclosed in exceptional circumstances).

If the situation cannot be resolved with the help of the Student Counselor, please contact the Student Ambassador or Head of Department or the Head of Studies.

Read more about the complaint process here.

If the offensive behavior involves either the Head of Studies or the Head of Department, please contact their next-level manger. Read more about the process in the here.

If you have experienced a criminal offence such as rape, attempted rape, violence, racism or similar, we urge you to contact the Police.

Emergency: (+45) 112,
Non-emergency (+45) 114.

If you have experienced rape or attempted rape, you can also get in touch with the Centre for Victims of Sexual Assault at Rigshospitalet, regardless of whether you decide to report to the police or not. In case of emergency a nurse at the centre is ready to help you 24/7: (+45) 35 45 50 32.

If you have experienced any form of online harassment or offensive behavior, you can also contact the StopChikane hotline for personal advice. Monday, Wednesday, Thursday 11-16: (+45) 28 89 40 70

6 CODE OF CONDUCT

Figure 6: Some pages of the DIKU code of conduct

MOBILIZING AND FACILITATING COLLABORATION AS A TACTIC

Creating sites that enable people to collaborate – in different ways and with different degrees of responsibility – is foundational to making institutional change. The tactic of mobilizing and facilitating collaboration relies on creating an *enabling ecosystem* that "brings out, catalyzes, and systemizes the resources potentially available. To do so, however, it must not only offer people the possibility of getting involved in the ways and times possible for them. It must also articulate a cultural proposal in such a way as to align it with their diverse motivations and/or trigger new ones" (Manzini, 2019, p. 64). By supporting the mobilization and facilitation of new coalitions driven by common interests, processes of doing and undoing can be led by many different actors, from managers to staff representatives to specialists working across multiple units, each bringing resources and different perspectives into play. This typically requires a process or attunement, adjusting to each other's views and positionalities. Anthropologists Jordan and Dalal argue that ethnographic approaches to culture change in organizations always require *persuasive encounters* in the form of "collaboration, compromise, coexperiencing; educating managers, technologists and administrators and getting educated ourselves. It is a long term-effort." (Jordan & Dalal, 2006). Throughout this three-year project, I have engaged in mobilizing or facilitating new alliances. These collaborative involvements all created new ways of enacting DEI work, with different people taking responsibility for new areas and new actions, in a diffractive way. This included, for instance:

- The cross-functional one-year initiative Inclusive DIKU (described below as an example of collective action).
- Meetings and workshops with Faculty managers (see paper 1) and administrative colleagues on topics as wide as accessibility, inclusive communication, hierarchies of knowledge in CS, sexual harassment.
- Creating new connections between teachers and disability officers (see paper 4), which in turn originated new forms of knowledge exchange.
- Supporting the kickstart of new DEI initiatives on neurodiversity by my colleagues such as a course on Critical Making and the planning of an event on dyslexia in computing education.

The creation of the Inclusive DIKU committee, and especially its work groups, is a good example of a collective action that generated new coalitions and practical change.

Collective action: the Inclusive DIKU program

Inclusive DIKU was the very first official program focused on DEI at DIKU. It was formed in 2021, as discussions on the new Code of Conduct brought up awareness of the many areas in which we need systematic change (read more in paper 1). The goal of the initiative was to map current issues and barriers to inclusivity and to release an internal report with strategic recommendations. As such, Inclusive DIKU became a way of integrating my research with the *situated knowledges* of colleagues tasked with DEI-related areas of competence, in a mutually enriching process. The initiative was planned to start and finish over 12 months and included a **Program group** - of which I was part, together with staff members in both research and administration - and a **Steering committee** chaired by the Head of the Department (see **fig. 7**).

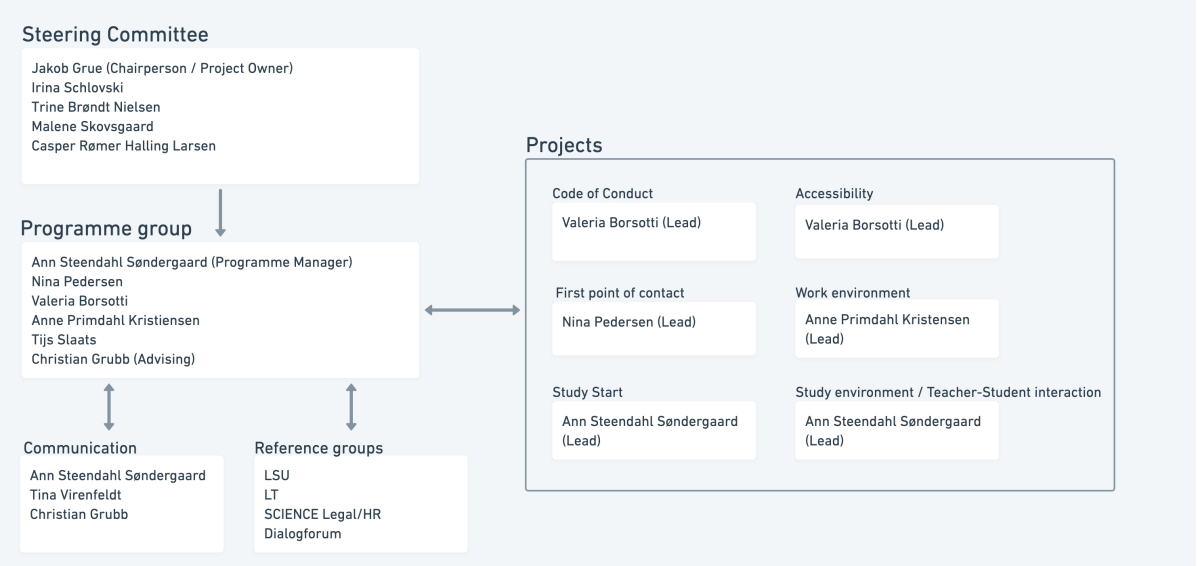


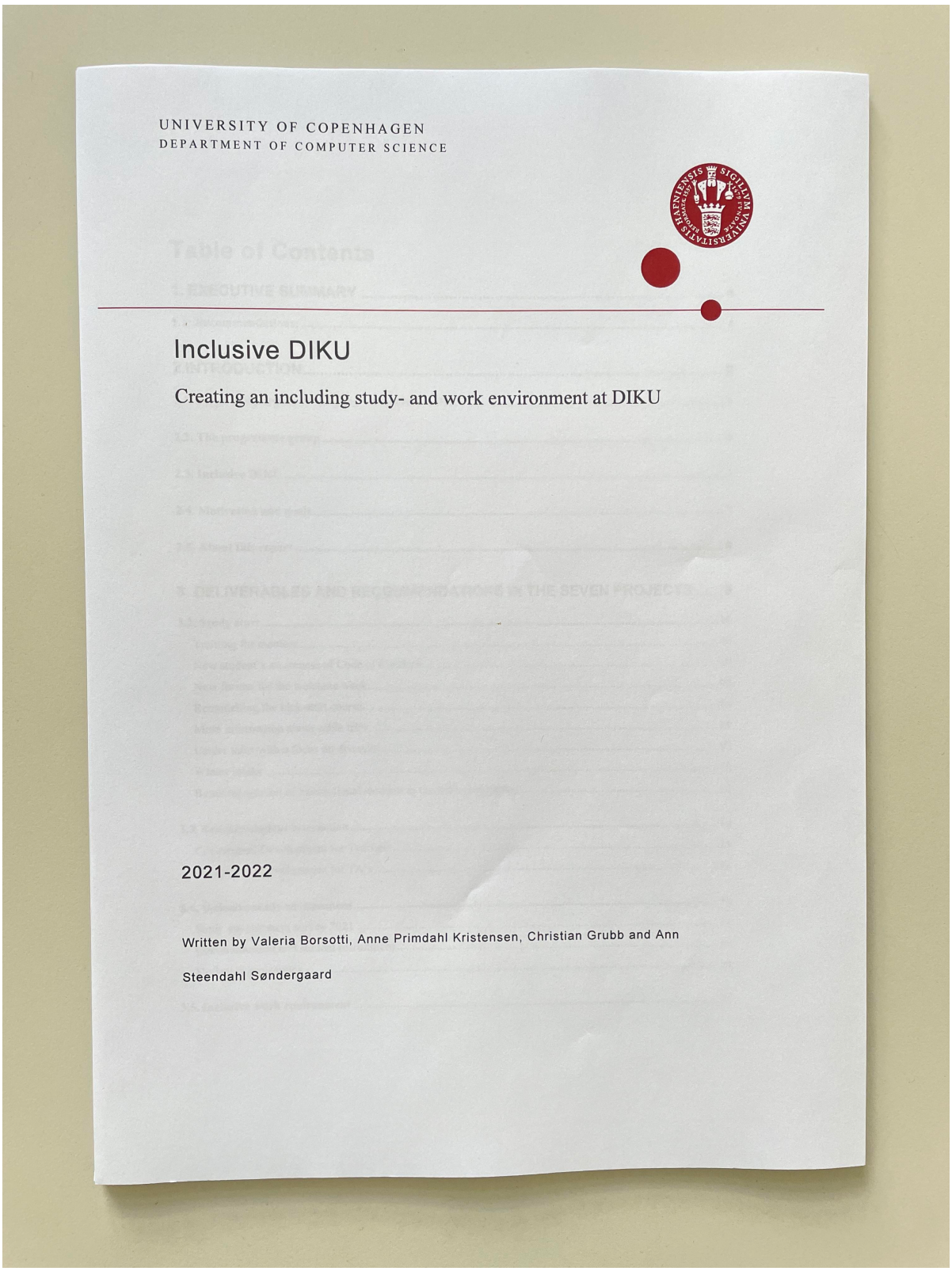
Figure 7: Diagram of the Inclusive DIKU organizational structure (from the official report).

Although the articles included in this thesis mostly focused on students, the Inclusive DIKU report had a broader scope, and covered several attitudinal and structural barriers impacting both students and staff. The Program group worked on seven focus areas, and was split into sub-groups for each of them:

- Study Environment
- Study Start (orientation week)
- Student-Teacher Interaction
- Work Environment
- Accessibility
- First Point of Contact
- Code of Conduct

At the end of the 12 months, our Program group co-authored a report with recommendations, some of which have already been implemented. The Inclusive DIKU report highlighted new areas of focus for strategic work (i.e. the training of management, staff and TAs on handling offensive behavior; improving grievance procedures; creating more accessible social events; integrating accessibility in the competence development of teachers). It sparked concrete changes, like the editing of the DIKU songbook and the creation of improved frames for inclusive social events (facilitated by a new officer working with social and study environment), an accessibility audit and certification, new ways to organize the study start and the beginning of a process for establishing better grievance procedures. The report also recommended advocating for structural change at Faculty and University level – a task that some managers have taken up as part of their work.

Members of the Inclusive DIKU program group were: Ann Steendahl Søndergaard (Project Manager), *Senior Consultant*; Nina Pedersen, *Academic Officer*; Valeria Borsotti, *PhD Student and Diversity Chair, Human-Centered Computing Section*; Tijs Slaats, *Associate Professor, SDPS Section*; Christian Grubb (Advising), *Special Consultant.*
At the time of writing, a new INCLUSIVE DIKU 2.0 is in the planning.


UNIVERSITY OF COPENHAGEN
DEPARTMENT OF COMPUTER SCIENCE
Inclusive DIKU
Creating an including study- and work environment at DIKU
2021-2022
Written by Valeria Borsotti, Anne Primdahl Kristensen, Christian Grubb and Ann Steendahl Søndergaard

NON-COMPLIANCE AS A TACTIC

Refusing to comply with rules is one of the most common tactics in equity-focused activism. Civil disobedience, a public breach of law intended to bring about change in laws or policies (Rawls, 1999) has a rich history worldwide, spanning from suffragists to African Americans fighting against segregation, such as Claudette Colvin and Rosa Parks refusing to give up their seats on the bus. Civil disobedience also has a rich tradition in universities – students might occupy buildings and disrupt classes, as it famously happened during the student rebellion in 1970 at UCPH, when students managed to obtain a more democratic institutional governance model (see also paper 2). Non-compliance in the workplace has been perhaps most brilliantly captured by Herman Melville in the comical story "Bartleby, the Scrivener" (1853) in which the main character, an employee at a law firm, suddenly refuses to execute the mundane task of copying documents, repeating 'I prefer not to'. As Deleuze noted, by not clearly saying 'yes' or 'no', Bartleby "hollows out an ever expanding zone of indiscernibility or indetermination between some nonpreferred activities and a preferable activity" (Deleuze, 1997, p. 71).

We often hear that much DEI work is 'just basic compliance' with regulations and not much else. In our case, sometimes change was only made possible by carving out a temporal and spatial 'zone of indetermination' (ibid) through **non-compliance**. One example is the implementation of gender-inclusive bathroom signage at DIKU.

Collective action: Gender-inclusive bathroom signage

This initiative was kicked off when a non-binary staff member wrote to me proposing that DIKU replace the gender-binary toilet signage with a gender-inclusive alternative. All toilets at the university were already unisex rather than gender segregated, but the signage represented a woman and a man silhouette separated by a line (see **figure 8** on the next page).

I suggested we re-design the toilet signage and install new signs all over campus in the occasion of the International Transgender Day of Visibility on March 31 (which was approaching). A positive response by DIKU management was followed by a collaborative re-design process. This involved the participation of students and staff identifying as trans* and non-binary. The final design includes female, transgender and male symbols.

The new gender-inclusive signs were hung in all the DIKU building on campus (see **figure 9** on the next page). However, shortly after, facilities management staff informed us that they needed

to be taken down as soon as possible after the International Transgender Day of Visbility, as they were not compliant with UCPH regulations. An officer from the authority regulating symbolic representations of toilet signage at our university - the Communication Department – refused to formally approve our new gender-inclusive signs as a *long-term* solution. The officer explained that the standard toilet sign at UCPH was to represent a person with a dress and a person with pants, clarifying that this symbol was inclusive because people of all genders wear dresses and pants. It was an odd conceptual schema: the binary as non-binary. We did not comply with the request to take down the signs but officially agreed that they would not be a long-term solution. Just like Bartleby, we preferred not to - for now. At the time of writing, the new signs are still up across all the buildings of the Computer Science department.

Figure 8: The old gender-binary toilet signage

Figure 9: The new gender-inclusive toilet signage at DIKU

OFFICIAL COMPLAINT AS A TACTIC

In her discussion of 'complaint activism' in the academy, Sara Ahmed argues that presenting an official complaint can be a politicizing process akin to participating in a protest: it comes from an experience of institutional failure, creates a record of what we do not want to reproduce, it makes it visible (S. Ahmed, 2021). She notes that this form of activism has a long history among Black British feminists and disability rights advocates. The tactic of using formal complaints to press for disability rights had been used at UCPH by Stine Nielsen, a visually impaired student of medicine who a few years ago had been denied by the Board of Studies the use of assistive technology software during exams. According to the UCPH newspaper Uniavisen[13], after the rejection and a failed appeal the student wrote an official complaint to the university's rector with the help of staff from the Danish Association for the Blind (DAB). The complaint stated that DAB would help the student with legal actions, including reporting UCPH to the Danish Board of Equal Treatment. One month later, Stine was allowed the accommodations required. This paved the way for other students with her same needs to find equitable conditions.
In the context of my research, an example of collective action utilizing official complaints is DIKU's attempt to change a mundane socio-technical access barrier (Spiel, 2021b), the binary gender categories in the HR management system of the university. This example shows how a local action can have repercussions across various scales, with the potential of creating broader change.

Collective action: Complaint about gender-binarism in the HR management system

One of the very first issues that was brought to my attention as Diversity Chair was that an international non-binary applicant – whose third gender was legally recognized in their country of origin - was not able to apply for a job in our department because our HR management system presented a non-optional choice of only two gender categories (male/female), see below.

[13] The English version of the article can be found here: https://uniavisen.dk/en/visually-impaired-student-in-year-long-fight-for-exam-software/ Accessed on January 6, 2024.

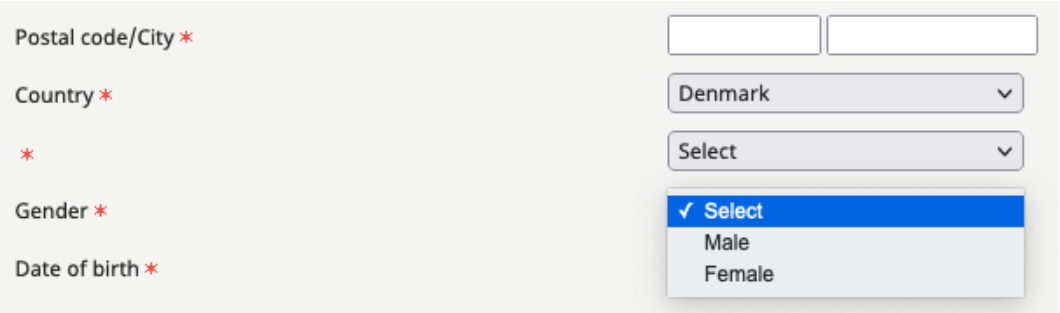


Figure 10: Gender data dropdown menu of the HR management system at UCPH (2020)

All Danish universities use the same HR management IT system. All of them, except for ITU, showed the same gender binary configuration. ITU presented 5 different gender options (see **figure 11**), including the option not to report one's gender. This inclusive design meant that people could choose whether or not they wanted to volunteer the information, and had more flexibility around categories.

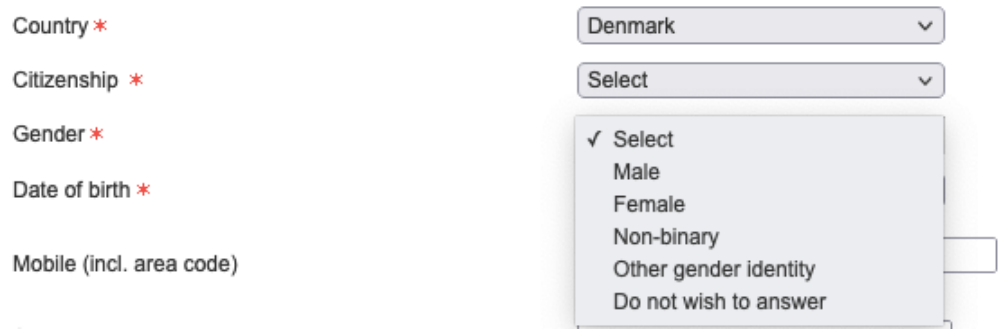


Figure 11: Gender data entry dropdown menu of the HR management system at ITU (2020)

Together with a manager at our department, in 2021 we presented a complaint to the Faculty administration, suggesting a more inclusive redesign of the dropdown menu based on the template created by ITU. After months of silence and a follow-up four months later, nothing was changed.

Meanwhile, a 2021 change in Danish law regulating gender discrimination (law nr. 2591 from 28/12/2021) stipulated that an employer must not request information about a person's *gender identity* (by which they indicated all genders aside from male and female) in connection with a recruitment process. According to the law, it is now only possible to request information on *binary gender markers* (male/female) because they are not considered 'gender identity'. This odd juxtaposition of 'gender markers' (M/F) and 'gender identity' is a good example of how 'sex' is typically assumed as the *natural background* against which gender is performed (Butler 1990).

This meant in practice that ITU also re-configured the job application interface with non-optional gender binarism for faculty positions. Interestingly, at the same time, ITU dropped the question about gender in all job applications for non-faculty positions.

Since the non-optional gender binarism was a concrete access barrier for some applicants, I contacted the Danish Institute of Human Rights (DIHR), the highest state agency working with issues related to discrimination in Denmark. The DIHR evaluated the non-optional binary-gendered question as problematic because it leads to discrimination on the grounds of 'gender identity' (as people with genders other than M/F are not able to apply).

The DIHR helped me present an official complaint to UCPH. One of their officers wrote a letter to central HR at the University of Copenhagen, suggesting to either leave the gender question out, or make it optional (the only two cases legally allowed in Denmark).
The Lead Diversity Officer at the University of Copenhagen wrote us that since the Ministry of Employment is the owner of the IT System, it is not possible to operate the change quickly, and added that our request kickstarted a discussion at national level on implementing the "prefer not to answer" option across all public organizations in Denmark, since they deploy the same system.
At the time of writing, the gender category dropdown menu of the HR management system is still configured with non-optional gender binarism, as well as in many other internal system.

Figure 12: DOREEN, original edition

Figure 13: DOREEN, card edition in German by Peter Purgathofer (TU Wien)

PLAY AS A TACTIC

The use of play as a tactic to raise awareness and provoke new reflections on social issues is becoming increasingly popular in both research and industry. Play is often used to expand the repertoire of possibilities in research-through-design approaches. Playful inquiry methods include exploratory design games (Brandt, 2006), feminist critical design artifacts (Bjørn & Rosner, 2021; Menendez-Blanco et al., 2018) and design parodies (Fox et al., 2018). Games are used by designers to raise awareness on social justice topics, like the Molleindustria radical games[14] on themes ranging from the Green Deal to mass incarceration, and playful facilitation methods such as Lego Serious Play. Play can be materialized by games, such as the ones I describe below as examples of our collective actions: DOREEN, a norm-critical game developed with my colleagues at DIKU, and BATL, a dilemma game co-developed with colleagues from the University of Southern Denmark. I will present both briefly as examples of collective actions based on play.

Collective actions: DOREEN and BATL

DOREEN is a norm-critical die game inspired by the mechanics of role-playing games (see paper 3 and **figure 12** in the previous page). The game was born from a collaboration with Jenny Vej, a computer science master student from DIKU whom I co-supervised together with Pernille Bjørn. Together with DIKU colleagues Pernille Bjørn, Valkyrie Savage and Morten Engell-Nørregård I co-created DOREEN, a game of provocations that engages players in reflecting on exclusionary narratives in computing, and envisioning alternative futures. DOREEN integrated empirical quotes from Jenny's thesis on the invisible experience of women students, together with quotes collected among researchers. The game was presented and played for the first time at NordiCHI in Arhus (Denmark) in 2022. Jenny Vej also presented the game during a DIKU Department Meeting and the DIKU Teacher's day.

Games are mobile and easy to adapt in different contexts. During my research stay at the Technical University of Vienna (TU WIEN) in 2023, Professor Peter Purgathofer expressed his interest in using the game as part of the curriculum. DOREEN has since been turned into a card game and translated by Peter Purgathofer where it was used as part of teaching during the first

[14] https://www.molleindustria.org/ accessed on Jan 8, 2024.

year Computer Science BS course 'Ways of Thinking Informatics' in 2023 at TU WIEN (**figure 12**).

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BATL[15] is a an open-access dilemma game I co-created in collaboration with staff at the University of Southern Denmark (SDU). The goal of BATL is to support and prepare university teachers in dealing with offensive behavior – such as sexist, racist or transphobic interactions they might experience in the classroom. The game is based on real-life vignettes from our own (or our colleagues) experience, in which teachers experiment with different ways of reflecting on and responding to negative interactions. We were brought together via two special interest groups hosted by the Danish Network for Educational Development in Higher Education: the *Bias Aware Teaching and Learning SIG* and *Teaching and Learning in the International Classroom SIG.* Several workshops have been held in Denmark using this tool, one of which was at our department during the DIKU's Teaching Day.

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Lastly, at the time of writing I am also collaborating with colleagues and students from different departments at UCPH as part of an expert panel co-designing a dilemma game on DEI and teaching at our university. The game is based on scenario-didactics based on our own experience as teachers and DEI practitioners/experts, and will be co-produced by a Danish game company. It will be used in teachers training to introduce topics related to equity and discrimination in teaching and learning – first deployed locally at the faculty of Public Health and then, if successful, in other departments at UCPH. The initiative is spearheaded by Janne Sørensen at the Faculty of Public Health, and originates in her and her colleagues' research addressing current equity issues in medical education, particularly regarding gaps and biases in the competence training (Sorensen et al., 2017, 2019, 2022).

[15] https://www.timeshighereducation.com/campus/managing-excluding-behaviour-and-bigotry-classroom

Figure 14: A photo from DIKU's first accessibility audit. The administrative directors and some students and staff representatives (pictured) follow the consultant on a walk around campus.

ACCESSIBILITY WALKS AS A TACTIC

This last tactic is inspired by a common participatory method from applied anthropology, the *transect walk* (Chambers, 1994). Transect walks - borrowed from the field of wildlife biology – were originally adopted by Chambers when he was assigned to do rapid assessments of rural villages' needs. With this method, applied researchers engage key informants for walks in the local settings, and observe and ask questions about what they encounter. Accessibility walks engage people with the goal of both mapping and sparking conversation about access barriers in physical environments. This tactic is also inspired by critical accessibility mapping initiatives such as 'Mapping Access' (Hamraie, 2018), a "critical design and participatory digital mapping project that uses campus spatial documentation to generate more politicized and intersectional interpretive relations surrounding access" (ibid, 256). We used accessibility walks as a tactic for raising awareness on accessibility barriers by engaging managers, student representatives and staff representatives in an accessibility audit of our campus, guided by an expert.

Collective action: DIKU accessibility audit

As part of my work with INCLUSIVE DIKU, I suggested hiring a consultant for an accessibility audit of our facilities. An expert from the company God Adgang (specialized in Universal Design and accessibility certification) led the administrative director of DIKU, a small group of student/staff representatives and myself through an accessibility tour of our buildings (including the 'porn toilet', see also paper 1). We walked through the facilities together (see **figure 14**), while the consultant measured a variety of spaces, took notes and pictures, all the while pointing to and explaining each single access barrier we encountered. She showed us several issues – for instance, many of the toilets for wheelchair users were not compliant with the latest accessibility requirements. In one case, the toilet was described by the consultant as a 'very fine accessible toilet' (fieldnotes), but the door width was not enough for a wheelchair to pass through. Similar issues were found in the elevators – some too tiny, or the door not wide enough. The consultant invited us to push doors, to move around the toilets, to get into elevators. She taught us about ergonomics, lights, sounds, and also about current regulations on accessibility. Across the buildings, some doors were too heavy, a ramp too steep. *None* of the wheelchair-accessible toilets in our oldest building on campus could be certified as fully accessible. According to the detailed accessibility description published by the consultant, and fully available (on the consultancy's website) people can read for instance: "The disabled toilet on the ground floor is from an older date and therefore not quite as large as a toilet should be today. It is, however, well furnished, and if you travel in a smaller wheelchair or with a walker, you will probably be able to

use the facilities. However, there is not much space to open the door, so you may need to ask for help. See the pictures so you can decide if it works for you."[16]

Thanks to the audit we can now link to a dedicated page on the consultancy's website which provides detailed information on the accessibility of our facilities such as the description above, and accurate photos. Before this, DIKU did not have any clear information on accessibility on the website, as is also the case for almost all the departments at the Faculty of Science (fieldnotes). At the time of writing, however, several of these accessibility issues have still not been addressed. Many of them require collaboration and support at Faculty and university level.

Figure 15: Two pictures of the porn toilet, showing furniture that renders the space inaccessible for wheelchair users. In the second photo, the accessibility consultant is taking pictures of the space.

[16] See the full details and pictures here: https://godadgang.dk/faktaark/koebenhavns-universitet-datalogisk-institut-bygning-1-toilet-i-stueplan-16942/data?filter=1

Conclusion

In this chapter, I presented and discussed the norm-critical and norm-creative modes of my research. I have also discussed issues of emotional well-being and the complexities of navigating hierarchies of knowledge in CS.

Through a process of *ongoing formative critique,* I have engaged in noticing and documenting sociomaterial practices and institutional dynamics with a focus on how they shaped equity, inclusivity and accessibility in our department. I negotiated new ways to foster institutional change, in an exploratory and collaborative process of impact that involved many *collective actions.* These were based on a set of tactics: recoding rules, mobilizing and facilitating collaboration, non-compliance, official complaint, play and accessibility walks. I argue that this non-linear process of ongoing formative critique - together with the tactics and collective actions generated diffractively throughout - has expanded the repertoire of possibilities for enacting DEI work in a research-based, collaborative way at DIKU. The impact diffracted across and beyond the department, too – as some of the examples listed above show. The game DOREEN was introduced as part of the curriculum in a large first-year computer science class at TU Wien, while the official complaint on gender categories in the HR management system might have repercussions at the national level. By doing and undoing institutional norms, practices, spaces and artifacts we opened up different ways of understanding and enacting DEI work in computing.

PART FOUR

THE RESEARCH ARTICLES

This thesis includes four articles.

Paper 1 is a methodological article. Anthropologist Samantha Breslin and I reflect on our experience of conducting action-oriented research in DEI institutional change initiatives in STEM. The article draws on two initiatives. The first one is in the US, where Samantha was hired as a postdoctoral fellow at the School of Engineering at the University of San Diego as part of the project Revolutionizing Engineering and Computer Science Departments (RED). The second one is in Denmark, where I was hired as a doctoral student as part of the FemTech project at DIKU to conduct research on equity at our department. We examine the process through which we made an impact and conceptualize it as *ongoing formative critique*.

We focus on three dimensions of this practice: noticing, documenting and negotiating. We discuss how we negotiated positionality, disciplinary norms, and interacted with a broad range of institutional actors in different positions of power. Through this engagement, we joined existing forms of local DEI work and generated new ones – in the paper we highlight the way in which this approach presents a way to navigate the complexity of DEI work and make change diffractively. The form of impact generated through ongoing formative critique cannot be evaluated quantitatively – but is a *formative* kind of impact: it generates shifts in awareness around systemic barriers to equity and practical changes in discursive, social and spatial practices. We also discuss the affective dimensions involved in this form of engagement and conclude with five actionable steps to support this type of work in organizations.

As I discussed in the Methods section of this thesis, the process of ongoing formative critique has generated several forms of practical change for DEI, which I term *collective actions*. This institutional process of change all started with my first study from 2021, which is here presented as Paper 2, but was chronologically the first paper to be written and published during my PhD.

Paper 2 presents a study that was initiated amid the Covid-19 pandemic, right at the beginning of my PhD. We examine how norms and values around gender and race are (re)produced in the traditions of humor of our department, as they have been historically encoded in sociomaterial artefacts, digital and physical spaces, and student rituals. Using a multi-sited ethnographic

approach (Marcus, 1995), we trace negative stereotyped narratives on gender and race and discuss how these normalize and reproduce dynamics of marginalization (*hygge* sexism). One of the main data sources for this project was the DIKU Student Songbook. What was very interesting for me in this project was digging into the role that the Songbook had as a *moral codex* of sorts. The articulation of femininity, masculinity and race reflected by the songs was often highly stereotyped, and infused with heterosexist and racist humor. We found for instance that the sexual objectification of women was a recurrent theme in most songs that mentioned them. The same sexualized humor was found in other spaces, such as Facebook groups and the student-run bar on campus. Similarly, we found marginalizing dynamics in the ways racialized global software developers were portrayed in the songs written by students. These songs combined a social critique of neocolonialist tech practices with negative stereotyped representation that dehumanized racialized programmers from Africa or 'the East'. We discuss how normalizing discriminatory social interactions as 'just jokes' risks negative consequences on the sense of belonging and wellbeing of social groups that are considered outside 'the norm', and how it complicates existing DEI initiatives in the department. We problematized the 'pipeline' approach to envisioning DEI change and instead propose an alternative strategy, *equity-focused institutional accountability,* formulated as a set of three principles. First, we suggest to examine organizational traditions, rituals and spaces to critically evaluate and address marginalizing dynamics. Second, we argue that critical reflection should be normalized in the core practices of the institutions. Third, we suggest diversifying and improving methods for data collection, to include diverse types of data concerning DEI efforts.

Paper 3 presents DOREEN, a norm-critical game of provocations. The article is based on the empirical data collected by DIKU student Jenny Vej as part of her master's thesis. DOREEN weaves in quotes from women students in computer science and questions from teachers, inviting critical reflection on structural gender barriers. We also explore stereotyped, devaluing attitudes toward human-centered disciplines in computer science. The game invites players to reflect on the transformative role of spaces of creative expression in our universities. The mechanics of DOREEN are inspired by role-playing games (RPGs) such as Dungeons and Dragons, a form of entertainment that is very popular among computer scientists and computer science students. We used intertextual design (Bjørn & Rosner, 2021) as a strategy to weave in pop-culture references - like RPGs and comics - to engage broader audiences in playful discussion about contested topics. The article includes a link to the full fabrication details of this open-source game.

Paper 4 presents the last study I conducted and is the only one that also includes participants outside of DIKU. This article contributes to CSCW research at the intersection of accessibility and neurodiversity. We examine the invisible *access labor* experienced by neurodivergent students in three Danish computer science institutions. While most studies on neurodiversity focus on autism, Adhd and/or dyslexia, we also include the perspective of folks with acquired neurodivergence – neurological conditions that develop as part of injury (such as post-concussion syndrome), illness or trauma (such as complex PTSD). The analytical framework draws from CSCW, crip theory and critical access studies. We use an exploratory and multi-stakeholder approach, drawing on interviews with students, teachers and disability officers, as well as document analysis. Our findings show that students encounter multi-layered, intersectional barriers to access in three main areas: assistive technology access barriers; cognitive and physical access barriers and social access barriers. But we also document how students improve collective access through micro-interventions – stressing the active role played by neurominorities and their allies in pushing for change. We explore how stigma, intersectional disadvantage and individualized approaches to disability shape critical access to resources, services and opportunities. We propose *access grafting* as a way to integrate strategic efforts by neurodivergent students and their allies. Access grafting is based on five principles: collaboration, intersectionality, situatedness, multiplicity and cripping the classroom.

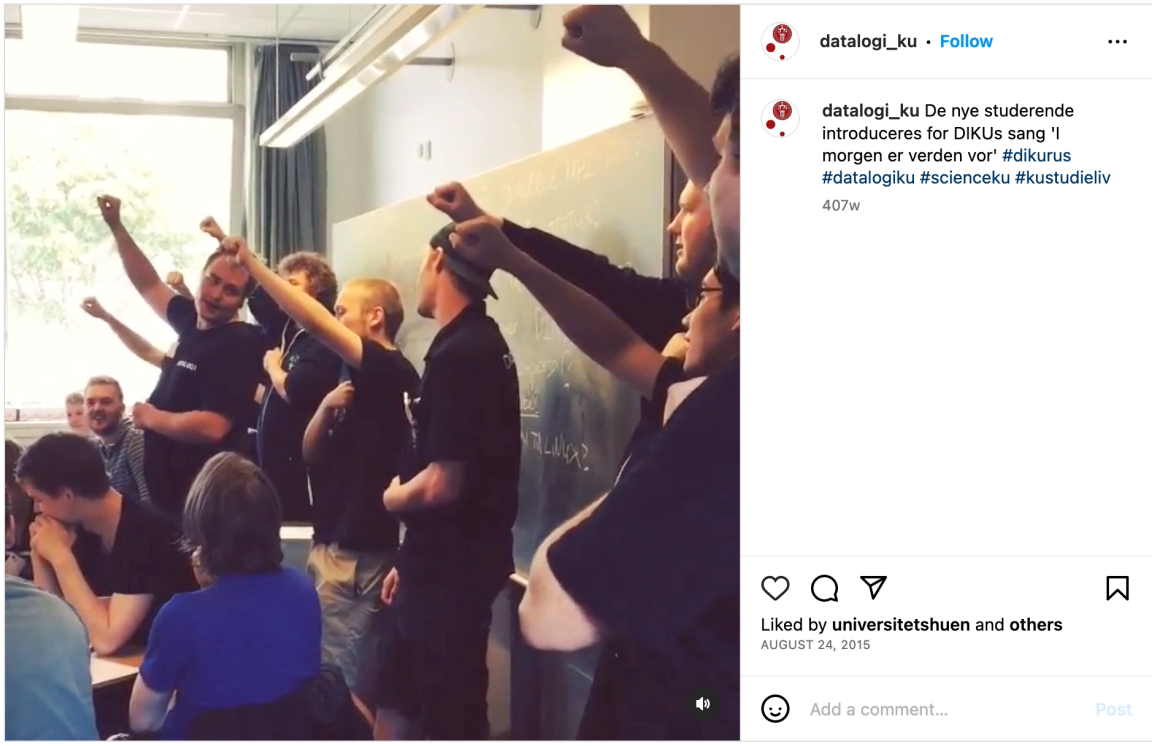

Figure 16: Screenshot from DIKU's official Instagram account, with a video of students performing the DIKU anthem 'I morgen er Verden Vor' (Tomorrow Belongs to Us) during orientation week.

The caption reads: "The new students are introduced to DIKU's song 'I morgen er verden vor'.

Ongoing Formative Critique: Working for Equity in Institutional and Interdisciplinary Change

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This manuscript will be included as a chapter in the forthcoming book *Documenting change anthropologically: The Copenhagen model of impact* [tentative title] edited by Stine Krøijer and Hanne Overgaard Mogensen [date tba].

Abstract

Anthropologists are often part of initiatives that seek to make institutional change in higher education towards diversity equity and inclusion (DEI). In interdisciplinary settings such as science, technology, and mathematics (STEM) fields, anthropologists are brought on board as consultants and experts about "the social" to provide insights on what and how to make changes to promote DEI. This paper examines the process through which anthropologists make an impact in such settings, conceptualizing it as a process of ongoing formative critique. The paper draws on two initiatives in university departments where the authors have been involved, originally framed as action-research projects: in computer science in Denmark (Valeria) and engineering in the US (Samantha). We discuss how working as anthropologists in such settings involves negotiating positionality and expertise, disciplinary norms, and with multiple actors in different positions (e.g. students, faculty, different levels of managers, etc.). This often includes taking a critical position relative to dominant practices and norms, but through which impact is made as part of an (often slow) engagement to produce awareness of organizational structures dynamics that negatively impact marginalized groups and DEI. This engagement entails joining and fostering forms of local involvement and interest in addressing issues relating to DEI while working to change institutional structures. We show how anthropologists play an essential role in everyday noticing, documenting, and negotiating as part of an adaptive formative process of building and cultivating competences for local awareness while also working to follow this awareness through to implementing small but diffractive forms of practical change for DEI.

1. Introduction

Anthropological expertise includes methods for studying organizational practices, as well as approaches and theories for analysing the operation of values, norms, and beliefs (i.e. culture), including in relation to gender, race and ethnicity, and social relations. Ethnography allows researchers to examine the privileged and marginalized narratives that exist within institutions, providing a better understanding of change processes (Czarniawska 2004). As such, anthropologists may often be involved as part of initiatives to make institutional change towards diversity, equity and inclusion (DEI), particularly in institutions of higher education. In interdisciplinary settings such as science, technology, engineering, and mathematics (STEM) fields, anthropologists are brought on board as consultants and experts about "the social" (Knox and John 2022, 20), including to provide insights on what and how to make changes to promote DEI. This paper examines the process through which anthropologists make an impact in such settings, conceptualizing it as a process of ongoing formative critique[1].

[1] The idea of formulating this practice as a "formative" form of evaluation and intervention was suggested by Stine Krøijer.

We define ongoing formative critique as a form of often-mundane feedback as part of the everyday interactions of anthropologists involved in projects of institutional change. We focus on three dimensions of this practice: noticing, documenting, and negotiating, which overlap and inform each other and operate recursively and diffractively. Noticing centres on observing institutional dynamics, social interactions, and organizational structures, as anthropologists are trained to do as part of participant observation, but with a focus of the ways those dynamics, interactions, and structures shape belonging, equity, and discrimination. Documenting similarly intertwines with anthropological practices of field-note-taking, interviewing, and other both classic and experimental methods. Documenting expands on what is noticed, to gather evidence, gain further insight, and engage others in the process of ongoing formative critique. Noticing and documenting are further part of negotiating and working to enact potential changes amidst a variety of actors and agendas.

Through these practices we also highlight the potential of ongoing formative critique to make both formative and diffractive change. Formative change creates moments of contingencies, or critical points of change following feedback (Black and Wiliam 2009). It is based in the concept of *formative evaluation* – also known as formative assessment – which was first introduced by Scriven in 1967 (Scriven 1966) in the context of evaluating educational curricula. The concept has been quickly adapted by many different fields, including international development (INTRAC 2017) and technology design (Egan et al. 1989). *Formative* assessment/evaluation is an ongoing, multi-stakeholder interactive feedback process that helps identify what works and what needs to be changed, pinpointing areas for improvement. Formative assessment in education, for instance, includes "all those activities undertaken by teachers, and/or by students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged" (Black and Wiliam 1998, 7–8). This is opposed to *summative* assessment, which is typically higher stakes, takes place against benchmarks and typically occurs at the end of a project.

Alongside these ongoing moments of intervention, we also show how ongoing formative critique can produce diffractive change through "small but consequential differences" in the world and expand beyond our own direct engagement (D. Haraway 1992). The optical metaphor of *diffraction* is used in feminist technology studies as a way to step out of objectivity within scientific thinking, toward a non-dualistic, dialogical, more "subtle vision" better attuned to difference (ibid). The term is also used to describe how researchers engage in making a difference in the world (Barad 2007; D. J. Haraway 2018). Thinking and acting in diffractive ways means engaging with the world by reading "through one another" (Barad 2007, 273), breaking hierarchies and emphasizing the relational aspects of knowing. We use diffractive change to discuss both this non-linear fanning out of change, and to consider how change can recursively expand outwards beyond ourselves and moments of formative intervention.

Working interdisciplinarily in projects of change in STEM settings, however, can present tensions. STEM fields often involve particular epistemological stances with a strong focus on problem solving that suggest particular modes of thinking and working where clear problems should be defined in order to develop concrete solutions (Breslin 2022). Ongoing formative critique presents a response and mode of navigating the "wicked problem" of DEI work (Rittel and Webber 1973), with an exploratory approach akin to some engineering practices such as tinkering. Tinkering refers to processes of experimental, incremental changes or modifications that do not follow formalized protocols, and in which the engineers or tech designers use readily available material to take things apart and put them together, creating new things or refining old designs. Ongoing formative critique captures an exploratory and collaborative process of impact (of "process impact") by anthropologists in much broader settings. As such, this form of impact has resonances with and is relevant to DEI and interdisciplinary work more broadly (Ahmed 2012; Ratzer et al. 2014).

Much of this work is shaped by our positionality. As women researchers with a social science background, we were part of a minoritized group in the STEM departments that employed us, but our perspectives "from the margins" are situated in a complex intersection of gender, race, class, and other identities (Harding 1986). Our understandings and embodied experiences – and the kind of impact we each had in our institutions, stem from our positionalities as educated, able-bodied white cis-gender women from Western backgrounds, as well as by complex power dynamics, institutional settings and working conditions in which we were socially embedded. Indeed, in many cases, our positions have been to speak on behalf of those from differing positions and experiences of marginalization. This work then is also a continual practice of noticing and negotiating how to do so in ways that are faithful and meaningful for others' experiences (cf. D. J. Haraway 1991; 1997).

In the next section we discuss the inspirations and methodologies this form of impact draws on. This is followed by two cases based on the authors' own experiences in different universities and departments: engineering in the US (Samantha) and computer science in Denmark (Valeria). Both initiatives were initially framed as action-research projects, but we discuss how our work involved negotiating positionality and expertise, disciplinary norms, and with multiple actors in different positions (e.g. students, faculty, different levels of managers, etc.). This often includes taking a critical position relative to dominant practices and norms, but through which impact is made as part of an (often slow) and experimental engagement to produce awareness of organizational structures dynamics that negatively impact marginalized groups and DEI. We conclude by discussing how ongoing formative critique provides both a means of intervention and, in its ongoingness, to examine the process of change in action. We also discuss the challenges and frustrations involved with this form of impact, including in relation to creating sustained and sustainable change.

2. Inspirations for Ongoing Formative Critique

We discuss here the connections of ongoing formative critique with feminist critiques of normativity and methodological dynamics of studying up and experimental collaboration. This overview highlights existing approaches to "process impact" in anthropology, which are often not named as such. In this way, we highlight the feminist and anthropological approaches to research and engagement that ongoing formative critique builds on, while also emphasizing the epistemological and affective challenges of this particular form of research.

2.1. Feminist critiques of normativity in technology studies

The critical work of making norms and values visible in engineering and computing institutions has a long history in feminist technology studies. Researchers introduced the concept of "co-production" to highlight how scientific knowledge and society reciprocally influence and shape each other (Faulkner 2001; Cockburn and Ormrod 1993), challenging traditional views of science as "neutral." Scientific knowledges are always inextricably situated in socio-cultural and political contexts, and inevitably intertwined with societal norms and concerns; the scientific "view from nowhere" makes certain identities – human, male, white, heterosexual – the standard, granting them neutrality (D. Haraway 1988). Based on years of "studying up" in tech labs in the 1980s and 1990s, Diana Forsythe's work examined how the assumptions of computer engineers influenced AI development and lab practices, showing that engineering knowledge - framed as universal and value-neutral – devalued users, patients, and the labour of women (D. Forsythe 2001). Working for decades at Xerox Parc, Lucy Suchman critiqued how assumptions about human interaction underlie the design of digital interfaces (L. A. Suchman 1987). Drawing on Donna Haraway's "Situated Knowledges" (D. Haraway 1988), Suchman also contributed to a critical examination of the professional practices and organizational arrangements that lead to common stances of technology production as "design from nowhere", obscuring professional responsibility (Suchman 2002). Scholars have shown how beliefs rooted in the symbolic association of technology with masculinity, and technical incompetence with femininity (Wajcman 1991) have been reproduced in the historical development and everyday practices of

computer science and engineering professions and education also for decades (Hicks 2017; Ensmenger 2010; Bjørn and Rosner 2021; Margolis and Fisher 2002; Faulkner 2009).

More recently, a growing body of feminist, queer, crip and critical race theory research in technical fields use a more explicit intersectional approach to analyse the multiple and overlapping dimensions of social inequality and technology. Researchers have examined how technology design and development (re)produce values and norms related to gender, ethnicity, race, disability, class and other identities, leading to inequitable societal outcomes (Costanza-Chock 2020; D'Ignazio and Klein 2020; Buolamwini and Gebru 2018; Spiel 2021; Benjamin 2019; Ogbonnaya-Ogburu et al. 2020; Bennett, Brady, and Branham 2018; Mack et al. 2022; Hamraie 2017). These biases are partially (re)produced by a persistent lack of critical and more socially responsible approaches to education and training in STEM technical fields. Alternative approaches to rethinking computer science and engineering education increasingly centre ethics, societal concerns and human values, providing students with the methodological and theoretical tools to design and develop accessible, equitable and inclusive technologies (Ko et al. 2020; Baker et al. 2022; Breslin and Wadhwa 2015; Bjørn, Menendez-Blanco, and Borsotti 2023; Friedman and Hendry 2019).

Values, norms and beliefs operate at different scales in STEM institutions – from the lab to the classroom, they shape epistemic practices (Breslin 2018; Hasse 2015) as well as the social and emotional life of students and staff (Borsotti and Bjørn 2022; Cheryan, Master, and Meltzoff 2015). Activist interventions and advocacy often play a key role in feminist and intersectional research. This might involve raising awareness about inequalities in creative and playful formats to reach audiences outside the academy (Menendez-Blanco et al. 2018; Fox, Lampe, and Rosner 2018); being engaged in policy advocacy (Hankivsky et al. 2014) and advancing structural change based on critical analysis of systemic issues within organizations. As such, ongoing formative critique is a transformative feminist approach that combines research with concrete interventions. As our cases illustrate, ongoing formative critique can have impact in many areas as we engage with a variety of stakeholders. The process of discussing common research concerns with our institutional partners is an integral part of the ethnographic encounter, and opens possibilities for diffractive change. This process of mutual engagement has much in common with "up ethnography" and more recent conceptualizations of collaborative ethnography.

2.2. From studying up to experimental collaborations

In her essay "Ethics and Politics of Studying Up in Technoscience", Forsythe notes how studies in the anthropology of science and technology almost always involve studying up (D. E. Forsythe 1999). The ethnographic tradition of studying complex organizations to bring change was consolidated in the 1970s, when new forms of anthropological activism emerged. In her influential essay "Up the anthropologist", Laura Nader argued for the need to re-orient ethnographic research towards "the culture of power rather than the culture of the powerless" (Nader, 1974, p. 289). Studying government agencies, bureaucratic institutions and powerful elites opened up possibilities for more democratic and just societies. But the intricacies of 'studying up' and investigating powerful organizations and institutions called for a remaking of norms and methods defining fieldwork and anthropological representation (Souleles 2018; 2021; Breslin 2022).

Nader formulated common obstacles to studying up in terms of access and rapport: the powerful are "out of reach on a number of different planes: they don't want to be studied; it is dangerous to study the powerful; they are busy people; they are not all in one place, and so on" (Nader, 1974, p. 302). She proposed de-emphasizing participant observation and experimenting with different methods such as document analysis (internal and external), interviews, and reflexive self-analysis. In a similar vein, Gusterson proposed *polymorphic engagement* as an effective way of studying up, interacting with informants across a variety of sites while "collecting data eclectically from a disparate array of sources in many different ways" (Gusterson, 1997, p. 116). While reflecting on her own experiences

studying up among computer engineers, Forsythe notes that this new type of fieldwork not only disrupts traditional ethnographic power relations and funding sources, but also make fieldworker and informants more vulnerable to each other (D. E. Forsythe 1999). However, she explained, “on the positive side, relocating and redefining fieldworkers and informants in relation to each other and changing the nature of the "field" and "fieldwork" offer the possibility of deeper understanding of complex social and technical processes” (ibid p. 3).

Today, anthropologists have come a long way in generating new approaches to collaboration in the field, experimenting with creative ways to navigate access, rapport, power relations and epistemic practices. Ethnography by design, for instance, conceptualizes interventions through cultivation and resonance and is based on “the use of imaginative and material practices to design ethnographically informed provocations in collaboration with publics who vet, co-design, experience” (Cantarella, Hegel, and Marcus 2020, 3). The workshops and artefacts created by Cantarella et al. are based on the fusion of transdisciplinary approaches and expertise in both scenography design and ethnography – creating an approach to anthropology that is inspired by the modalities of design. In a similar vein, Estalella and Criado propose new experimental approaches to doing fieldwork in “para-sitical” contexts, or sites populated by scientists, administrators, designers and activists, in which the anthropologist often develops new forms of engagements and reconsider epistemic practices (Estalella and Criado 2018).

Traditional participant observation is substituted or mixed-up with multiple forms of collaboration in the production of knowledge. Through “fieldwork devices - such as coproduced books, the circulation of repurposed data, co-organized events, authorization protocols, relational frictions, and social rhythms – anthropologists engage with their counterparts in the field in the construction of joint anthropological problematizations”(Estalella and Criado 2018, 2). This form of collaborative research has provided an inspiration for practices of working with engineers and computer scientists in our work, in terms of the ways that we share knowledge and how we design and practice research and interventions. Ongoing formative critique is about non-linear, diffractive change. It involves emerging collaborations and a mutual process of transformation, where the researcher and the organizational stakeholders work together toward institutional change. We now turn to discussing our own cases of enacting ongoing formative critique.

3. Samantha: Revolutionizing Engineering Education in the US

I was hired as a postdoctoral fellow at the Shiley-Marcos School of Engineering at the University of San Diego (a private Catholic university) as part of a project with a USD$5 million grant from the US National Science Foundation (NSF) Revolutionizing Engineering and Computer Science Departments (RED).[2] The project entailed a variety of efforts to make “Changemaking Engineers,” including through curricular changes and to develop the value of “sociotechnical engineering” within the School (Lord et al. 2020; Roberts and Lord 2020). The grant team was made up of the Dean and Associate Dean for the School, the three department chairs at the time of the grant application, and a social scientist. The grant was also happening in the context of broader institutional changes, including general growth of the size of the School and a cluster hire of faculty in Integrated Engineering.

I worked with the social scientist on the team (Dr. Michelle M. Camacho) to study the forms of change happening through the grant, while also working with the engineers on the grant team and in the School more broadly to contribute to that change by, for example, developing modules for courses that integrated social perspectives on mineral extraction or electronic waste (e.g. Lord et al. 2018; Breslin et al. 2020). This was a dual-role in the sense that I was working to implement the grant-work in process while also studying the grant from a social science perspective. It also meant navigating a

[2] This research was supported by a grant from the National Science Foundation, Award #1519453 IUSE/PFE RED: Developing Changemaking Engineers.

landscape in the team and School with many different ideas of what this means, with different personal histories and investments in what change looks like, and different perspectives on how anthropological approaches to research might fit in.

I started on the project halfway through the grant. Just prior to my start, the grant team had made a change from external evaluators responsible for documenting and evaluating the grant, to be instead supported by an external advisory board. As highlighted by the team in an annual report, the board "encouraged us to worry less about the number of course modules we develop and the number of faculty who attend workshops, and to think more about the root causes of the current culture of engineering and engineering education" (Olson et al. 2019). The approach I took to my work as an anthropologist on the team was then shaped and facilitated by the framing of the advisory board members, which consisted of several senior scholars in Engineering Studies with expertise in social justice and social (science) perspectives on engineering. I was also building on the work of the anthropologist who had held my position previously (Dr. Elizabeth Reddy). The framing of the advisory board and some of the approaches followed by Elizabeth gave me space to engage in my dual-role in a way that felt meaningful and valuable as an anthropologist, in particular through ongoing formative critique.[3] I discuss two separate cases that involve noticing, documenting, and negotiating.

3.1. Noticing Language and Interviewing for Inclusion

In the first case, working with Michelle, we settled on the looking at change through language, and specifically metaphor, particularly among grant team members, which also resulted in a publication (Breslin and Camacho 2021). This focus emerged both through noticing language used by team members as they expressed frustration over tensions within the school and their efforts as part of the grant to pursue and promote a sociotechnical approach to engineering. It also emerged as part of a negotiation with the team over *how* to examine and document change in relation to the grant. We had initially planned a set of focus groups and then a survey to follow up on the initial "baseline" work done by external evaluators, but team members raised concerns that discussion around a survey could incite further tensions in the School. As a result, I instead conducted interviews with as many faculty members as possible, including grant team members. This enabled greater confidentiality and personal interaction with faculty in the School. While ultimately beneficial, these negotiations nonetheless also involved confusion and frustration on my part around the role and freedom of/for social science work as part of the project.

Interviews with faculty members outside the team were facilitated by my position as a postdoc and as a social scientist, having not been embroiled in School history or politics and having limited power both in terms of my rank and relative to any decisions in engineering. Michelle's reputation as a scholar also facilitated some of these connections. That is, we were seen, in some but certainly not all cases, as partially separate from the grant. This gave me space to travel between the grant team and other members of the School. I also discuss the value of interviews further below.

In our article, however, we decided to focus on the changes that were happening within the team itself. This was the space where we had the most regular access and contact throughout our work and where we were discussing our ongoing research goals as social scientists. Indeed, one of the effects of discussing what we had observed and our discussions in writing the paper was for the team members to themselves be more aware of the metaphors they were using to discuss efforts for change. At first, these were largely based on metaphors of war such as "bullets" being fired, but with some shifting to metaphors of religious conversion such as "evangelizing" the grant, and later shifting to metaphors of care (Breslin and Camacho 2021). In this sense, the discussion of language was a formative intervention where, as we argue in the paper, changing language is significant in relation to the

[3] See also Elizabeth's discussion on how she collaborates with engineers in her own research (Reddy 2023).

worldviews that metaphors embody and the possibilities for *how* to enact change and support the grant goals, which included peace and social justice.

Beyond the specific focus on language, interviews gave members of the grant team and others in the faculty space to reflect on and think about their own perspectives of change, and sometimes to shift them (Breslin and Camacho 2021, 66–67). Noticing, in this sense, was not just done by social scientists, but rather engaging in these practices can prompt and provide openings and opportunities for others to notice and reflect on their perspectives. The woman member of the team, for example, engaged actively with the drafts of our paper. She highlighted to us the ways it did – and did not – adequately reflect her experiences and our choice to use gender-neutral pseudonyms and pronouns in the paper minimized painful experiences in engineering (Breslin and Camacho 2021, 58). Interviews and the practice of ongoing formative critique was, in this sense, sometimes emotional for both myself and those I met with who detailed their experiences of discrimination and harassment in engineering.

Interviews, however, also incidentally provided insight into how faculty members saw and valued the work of social scientists (all anthropologists) who had been part of the team. For example, when I asked at the end of an interview with engineering grant team member if they had anything to add, they responded:

I want to share that I have learned so much over the last year-and-a-half from all of the social scientists on the project and I think that that's not a resource or a collaboration, that is a fundamental cornerstone for the project. I'm a better researcher, I'm a better designer because of the things that I've been learning and hearing from these awesome social scientists. And I would recommend that any time you're trying to do any of this type of work, there should be a social scientist on the project … So thank you. And thanks for asking to interview me… nobody's asked to talk to me yet, so this is cool.

As this person highlights, interviews then also served as a way to further include people in the grant process – even team members who should ostensibly already have been included, but didn't always feel as such. It provided space for their thoughts and reflections, along with a sense that these thoughts and reflections mattered.

In this case, the publication itself has thus far produced limited "impact" in terms of citations, but the process of conducting anthropological research and producing the publication, including discussing and negotiating the contents with team members as part of the publication process, produced an impact in relation to changing language, along with the changes in perspectives that metaphors entail, and in relation to inclusion. In terms of documenting anthropological impact, this attention to our role could have been made a more deliberate focus in interviews to elicit these reflections more systematically. As discussed in the next case, some of the change fostered through these practices of noticing, negotiating, and documenting are diffractive. As such, further interviews a year or several years later could be helpful in elucidating and documenting change.

3.2. Collaboration and Diffraction

These diffractive effects are a key component of the second case. As mentioned above, there was a cluster hire of faculty for Integrated Engineering around the time of the grant. Integrated Engineering was a new program in the School focusing on a broader and interdisciplinary approach to engineering problems. Dr. Diana A. Chen and Dr. Joel Alejandro Mejia were two of the engineers hired to teach in this program and became co- and lead- authors on an article about their experiences as minority faculty doing equity work in engineering. Their work was often celebrated and claimed by the grant, even as they were generally not included as part of grant team members. Their work, however, was essential to and fundamentally intertwined with the goals of the grant.

A collaboration with them started after I circulated a call for papers for a special issue on "hybrid pedagogies" that I thought might be relevant to them or others doing work around the grant goals.

Diana contacted Alex and I saying she was interested in submitting something about their teaching, organizational efforts, and curriculum development in Integrated Engineering, the development of a core course on User Centered Design, and what it means to do this as junior faculty of colour. This began our collaboration for the article. Diana and Alex had been working and writing together previously in relation to their work in Integrated Engineering (e.g. Hoople et al. 2018; Mejia et al. 2018). The article for the special issue provided a venue to reflect further on the social conditions of their work (see Chen, Mejia, and Breslin 2019).

While planning and drafting the article, we had a variety of discussions about their experiences, what we could say about them analytically from a social science perspective, and what writing such a paper would mean. It posed a potential risk that they may lose the support they had from others, necessary for their careers, in publicly highlighting the challenges and inequities they faced both as minority faculty and not-yet-tenured. I was largely shielded from this as a white social scientist whose role it was to conduct such an analysis and given I was on a temporary contract anyways. Noticing and negotiating emerged through such discussions, but also as a continuation of Diana and Alex's own practices of noticing. As we discuss in the paper, "these conversations illuminated how our experiences were shared or diverged in relation to our different positionalities" (Chen, Mejia, and Breslin 2019, 333). Through the paper, we put those experiences into a conceptual frame where they could be connected with discussions about positionality, hegemony, and microaggressions, and thus the broader implications and challenges of doing equity work in engineering and in higher education. The publication was itself a documenting of their experiences, alongside my observations as a "resident social scientist" (Chen, Mejia, and Breslin 2019, 333).

As with the previous case, the publication is, in one sense, a more traditional form of impact. The paper may be taken up by others and used for insight and inspiration to change, for example, the ways teaching expertise is distributed according to types of courses, which is one of the issues highlighted. It has indeed gained some circulation in terms of citations, primarily in engineering studies. In terms of change within the School, the publication was read by some in grant team internally. As with the previous case, discussions of inequities produced a range of emotions and reactions – from support to distress – read through different positionalities. As mentioned above, the publication served as an assertion of evidence that could not be easily ignored, in alignment with formative intervention via feminist (and anti-racist) critique as discussed above. Alex highlighted to me how the publication served as a kind of proof that it's difficult to do this work and a kind of catharsis in relation to their experiences.

A significant form of impact for this paper was also in its diffractive effects. The issues raised in the paper intertwined with plans and possibilities for further engagement within the School and by Diana and Alex as part of their own research agendas. Diana has taken up some of the insights on how to think about analysing her own experiences. Given that I left my position to move to Copenhagen as we were revising the article, learning about and documenting this impact was happenstance. Diana made a casual note in an email correspondence that mentioned how our work on the paper had encouraged her to take her work in new directions. I later followed up for my tenure file, where she elaborated:

Your expertise in feminist studies and qualitative research gave me a scholarly foundation upon which I can do DEI and social justice work as a part of my teaching and research, not just my service. That leverage has helped me carve out a niche as a budding expert in integrating social justice into engineering curricula, including offering 8 professional development workshops for other institutions to start doing this work. (Chen, personal correspondence).

Diana highlights how it was the way of understanding and producing knowledge as based on her own experiences, developed through the collaboration as part of discussing anthropological ways of knowing that has had an impact (e.g. Chen, Hoople, Leydens, et al. 2023). This further contributed to

her research on supporting faculty in reflecting on systems of privilege in engineering (National Science Foundation 2022a). Similarly, in following up with Alex about *this* paper, he discussed how the reactions to our joint publication provided him with insights for further work on scripts of whiteness, and how conversations with the anthropologists over time have contributed to thinking more broadly in his work and in doing ethnographic research (e.g. Chen, Hoople, Mejia, et al. 2023; National Science Foundation 2022b; 2023b; 2023a).

A key facet of these kinds of diffractive effects is that they have the potential to be both much broader and more sustained. Both Diana and Alex have expanded their work. Diana is offering workshops to other institutions and taken her research in new directions and collaborations, and Alex has pursued several new grants and research projects. Following up with Alex and Diana have contributed to documenting these diffractive effects. Further follow-up work (observations and interviews) could examine what has changed (or not) at the School and in other places that have drawn insight from this publication. This would more systematically document processes of change and connects with methods of, for example, of reading *with* documents (Jensen and Lauritsen 2005).

4. Valeria: Computer Science for all?

In 2020, I was hired as a doctoral Fellow at the Department of Computer Science, University of Copenhagen (DIKU), as part of the FemTech.dk program, established at DIKU in 2016 by computer science Professor Pernille Bjørn and financed by the department. The initiative had been a powerhouse of research- and design-based interventions to challenge gendered narratives in computer science. It had a strong focus on outreach to wider audiences and STEAM[4] educational activities targeting youth. My project, supervised by Pernille, was geared towards researching DEI challenges at our own institution. My work was built on Pernille's own practice of noticing the challenges and social inequities experienced by women and non-binary students at DIKU. This research was situated in Denmark's first computer science department, founded in 1970 and counting over 200 employees and around 1200 students.

My research explored the values and social norms operating in some of DIKU's everyday practices, artefacts, and spaces (digital and physical), particularly in relation to gender and disability. The disability focus emerged few months into my PhD through my practice of noticing multiple accessibility breakdowns and barriers experienced by students. My goal was to make formative interventions and generate diffractive change and discussion through multiple interventions and critical artefacts with students and staff. I was inspired by research studies that highlighted norms in computing education to generate effective interventions (Alvarado and Dodds 2010; Margolis and Fisher 2002). My experience had been both exciting and frustrating. The pace of institutional change – shaped by cultural and bureaucratic roadblocks – was much slower than the pace of publishing expected in a PhD program in Computer Science. In addition, I needed to readjust my methods due to multiple Covid-19 lockdowns and explored creative ways to carry out my research (Lupton 2021).

I had a dual role in the institution throughout the whole project. I was both a Ph.D. student and the first Diversity Chair at the Computer Science department. I was a chair without a committee, my tasks being more of a consulting nature – advising and creating a dialogue with executive management and staff on strategic DEI initiatives. For this, I also built on my previous professional experience as a DEI Special Advisor at the IT University of Copenhagen. My PhD advisor Pernille, who became DIKU's first female full professor in 2015 (45 years after the department's establishment) also had a dual role as Professor and as executive, since she was Deputy Head of Department for Research. My formal role as Diversity Chair reinforced legitimacy and was key in operationalizing institutional change.

[4] STEAM indicate activities based on bridging arts and science. The acronym stands for Science, Technology, Engineering, Arts and Maths.

My positionality as PhD/Diversity Chair facilitated access to the field, but also meant navigating complex social and power dynamics. Being assigned the role of critiquing my institution, together with the inability to remove myself from the field for most of my fieldwork, also generated complex emotions. I'll unpack some of these intricacies before discussing the impact of my work at DIKU, because emotional labour and emotional reflexivity shaped the ways I engaged with the field. The strategies through which I understood and managed my emotions, often through discussions and ad-hoc support networks, were crucial in making my work impactful. Being the Diversity Chair gave me authority – it helped me to find information, reach out to people in the organization and become a catalyst for small or larger organizational changes. But openly documenting and critiquing local heterosexist practices and traditions while being a woman in a majority-male department (with a majority-male student population) was bound up in emotions. Like pain – the pain of listening to a student recounting her experience with sexual harassment; anger – when faced with unexpected blocks to proposed initiatives; fear – when we experience discomfort about the possible consequences I/we could face in making certain things visible. But also joy, the joy of finding allies in unexpected people and places, or when celebrating a collective success.

In addition, by being somewhat of a disciplinary "outsider" (the first PhD student at DIKU with a MSc in Anthropology) I sometimes clashed with the ethos of engineering rigor (Riley 2017). While the use of anthropological methods and theory in HCI and CSCW is not uncommon, I occasionally encountered comments that devalued qualitative methods and gender analysis as outside the scope of computer science. Finally, I had to navigate ways to set healthy boundaries between "research time" and "DEI work time" to care for my well-being. To address these challenges, I found support through regular counselling, discussions with my advisor and with other transdisciplinary computer science colleagues at dedicated conference workshops and panels (Feuston et al. 2022; Lee et al. 2021; Bjørn et al. 2022). These discussions opened up reflections on how to build solidarity and community, both locally and internationally, and created safe spaces to openly address and recognize the emotional labour of doing research in complex interwoven environments. In the following sub-sections, I will present an overview of some of my work at DIKU, discussing the process of noticing, documenting and negotiating as it unfolded.

4.1. Noticing and documenting stereotyped humour and exclusionary norms

I started my project by noticing and documenting how stereotyped humour was (re)produced in the computer science departments' traditions and rituals (Borsotti and Bjørn 2022). Humour has traditionally played an important role in computing cultures and engineering – from the funny "easter eggs"(hidden images or messages) built into the software of search engines like Google – to practices like "hacking", the MIT long-standing tradition of designing and implementing clever and funny tricks and pranks (Peterson 2003). Many computer science departments in different countries also have popular musical theatres that feature satirical computer-related shows. In fact, computing "filks"(parody songs) have been popular in universities and computing environments for decades. As I found out at the beginning of my project, DIKU had a strong tradition of satirical theatre ever since the 1970s, and "filks" written by students became part of the departmental "group-singing" tradition (fællesang).

I approached this exploration with a multi-sited ethnography approach (Marcus 1995) following strands of humour as they emerged in various sites – I centred the study of artefacts, spaces and documents (both off and online) and interviews with staff and students. The point of departure was the analysis of the latest DIKU Songbook (fig. 1), created and edited by a student society at the department, distributed to all first-year BS students each year, and used during the orientation week and cabin trips. Most songs in the book were written by students as part of the musical theatre (Revy), ranged from various decades, and included songs by the Maths and the Physics Revy as well.

In the paper, Pernille and I trace three strands of stereotyped narratives that emerged from songs: gendered stereotyped about geeks and nerds, typified as male; stereotyped racialized narratives on global software developers; and stereotyped narratives about women. In most songs where women appeared, they were sexualized or represented as objects of desire. Racial, transphobic and homophobic slurs and jokes were also part of the repertoire. Similar humour resurfaced in the Facebook groups created by DIKU students and specializing in memes (fig. 2), particularly a group which featured racist, homophobic, sexist and anti-feminist jokes. The paper also discussed episodes of micro-aggressions and "hygge sexism" experienced by students, and examined cases of disruptive inappropriate behaviour in the classroom experienced by teachers.

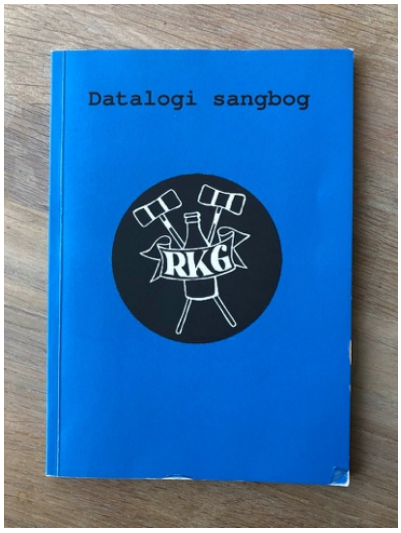

Figure 1 *(to the left)The DIKU songbook and* ***Figure 2*** *(top) a meme from the DIKU Facebook group run by students*

Humour sexualizing women was also present in spaces on campus, like the "Porn toilet" (fig. 3) the disabled people's toilet at the student café that was decorated with images of naked women, red lights, and stickers of heterosexual couples having sex. The porn toilet was an inside joke about computer scientists (coded as male geeks) never having sex, and the extra furniture in the space – added for the sake of the joke –rendered it inaccessible. What started as an exploration of humour, ended up highlighting accessibility issues and centering disability in discussions of DEI.

Figure 2: *The 'porn toilet'*

Pernille and I defined our article as an intervention. Throwing into relief, publicly, the issues we examined was indeed the beginning of many new steps towards change. In the paper, we discussed the implications of stereotyped narratives and exclusionary mechanisms on the wellbeing and sense of belonging of marginalized groups in computing, and propose a set of practical recommendations. The process of diffractive change that followed was not linear, and it reached outside the boundaries of our department.

4.2. Into the flow: from new policy work to accessibility walks

By writing and publishing this paper on humour in computing, we spelled out issues that were implicit, and made a clear call for institutional accountability, which included a call for new

non-statistical ways of framing "diversity." During official department meetings and teachers' meetings, the topic of "student diversity" was typically brought up only in the context of binary gender statistics of students' enrolment. But participating in meetings among study environment administrators I noticed a different way of articulating issues of "diversity." Administrators were discussing inclusivity issues and disruptive behaviour rather than enrolment stats. Our study focused on inclusivity and identified structural and attitudinal barriers, kickstarting work to better prevent and handle sexual harassments and discrimination. Bringing the discussion of my research findings in meetings with management and DIKU staff provoked a rich flow of interventions and collaborative artefacts, which engaged students, staff and employees at other universities. As Pernille put it, I provided a *language to talk about these issues*, framing them in ways that better enabled change.

I suggested the creation of a new Code of Conduct (CoC) since the existing "house rules" (sic) were mostly focused on interaction with physical facilities, and had no clear information on shared values, clear pathways for reporting and grieving procedures. Existing KU regulations – mostly written in legalese - were dispersed in different online documents, and rendered almost invisible to staff and students. I argued that concretely working on preventing and handling discrimination and harassment was foundational to any further DEI effort at the department, as reasons behind inadequate reporting are largely due to lack of clear protocols and information, alongside power dynamics (analyse og tal). My proposal was approved. I drafted the new CoC collating existing KU policies, implementing best practices, and making sure to communicate multiple reporting and psychological support pathways (including external stakeholders like a digital harassment support group). The new CoC was kicked off after an iterative process of discussion with different stakeholders, from HR to local DIKU staff.

This was followed by a nonlinear flow of organizational change(s) in multiple directions. According to an internal document:

> *The new Code of Conduct was a starting point to kick-start a bigger process which became Inclusive DIKU (...) For the new Code of Conduct to have the desired effect (...) a cultural change among employees and students at DIKU was needed in order to foster a more inclusive and diverse work- and study place in the years to come.*

Inclusive DIKU was a year-long initiative, and I was part of its "programme group"[5]. Our small committee met regularly to define crucial areas for DEI work at DIKU, highlighting issues and proposing strategies. We were further divided into smaller sub-groups: I created and oversaw the Code of Conduct subgroup, and the Accessibility subgroup. Our work was periodically reviewed by a steering committee chaired by DIKU's Head of Department. The initiative was closed after one year and the programme group delivered a full report that included several recommendations for DEI work. At the time of writing, DIKU is about to launch "Inclusive DIKU 2.0".

Working together with the program group and co-authoring the report generated both diffractive knowledge and diffractive change in unexpected directions. Equity work is always collaborative and multi-scalar, it occurs - or it gets jammed - at the intersection of multiple collectives and institutional sites (Ahmed 2017). The work of Inclusive DIKU and attempts at generating interventions involved a laborious process of tracing who was accountable for a broad variety of issues and areas, which in turn led to carving new paths for collaboration across different sites – and generated new insights for my research, in a recursive process. DIKU is situated within the Faculty of Science, and embedded in a complex system of administrative and collegial units. While documenting how many cases of sexual harassment or discrimination among DIKU students were reported to the Science faculty counsellors,

[5] The other DIKU employees part of the group were Nina Pedersen, Ann Steendahl Søndergaard, Anne Primdahl Kristiensen, Christian Grubb and Tijs Slaats - the only other researcher in the group aside from me.

for instance, I found that the counsellors' office did not archive the reports in a system that would allow statistics or historical records to be compiled. As a result of my request for information, the counsellors decided on the introduction of categories for the classification of incoming reports, for easier retrieval.

In some cases, the scale of change required to address systemic DEI barriers was bigger than our department, and our interventions reached a halt. A presentation of the paper on humour to a group of managers from the Faculty of Science resulted in a heated discussion about the "porn toilet", and generated strong emotions – mostly anger and surprise. The toilet was shortly after redecorated removing sexualized references – but at the time of writing, the toilet is still fully inaccessible to wheelchair users. As part of our work with Inclusive DIKU, we invited an accessibility consultant for an audit of facilities on campus, a two-hour walk in which I participated together with other DIKU staff and students. We found that many "accessible" restrooms at DIKU did not fully comply to standards. While students at the café expressed interest in retrofitting the "porn toilet" and communicated with the consultant, support from central authorities at the university was lacking, and students had to drop the project. Finally, the Facebook meme group featuring sexist, racist and homophobic humor was deemed by Meta officially in alignment with "community guidelines" - nor DIKU's name could be removed from it, since its administrator (a former PhD student) was not responsive to emails. These frustrations and frictions allowed us to map the complex ecosystem of stakeholders we needed to engage for sustainable local DEI change. This process resulted in DIKU staff – myself included - advocating for strategic change at Faculty and university level.

Interestingly, while some researchers had the tendency to refer to the work we were doing as "interventions", people in the administration from the start framed them as part of bigger "projects" to implement. This different framing revealed different ways of making sense of projects of institutional change – "intervention" is commonly used in design fields (like CSCW) to indicate (creative) actions that address specific problems, an approach that I thought also nicely fit the fast-paced timelines of academic publishing in STEM. "Projects" are time-limited and very structured managerial practices, they fit with institutional budgeting and division of labor. I saw our work as something in the middle, more in alignment with how Cantarella et al. describe their scenographic experiments in fieldwork: "perhaps a better metaphor than intervention would be to think of the process as one of cultivation. In cultivation, changes develop slowly through the establishment of root structures and subterranean conditions. Only then do they begin to thrive" (Cantarella, Hegel, and Marcus 2020, 53). However we framed our initiatives, we all agreed that they introduced some radical change – radical in the sense of 'establishing new roots' – our process impact diffracting from discrete interventions or projects.

I also co-created two open-source, norm-critical artefacts to stimulate discussions on normativities in science and computing education: DOREEN, a "game of provocations" CS (Vej et al. 2022) and the BATL tool[6], an interactive workshop to prepare university teachers for unanticipated interactions such as racist, sexist or transphobic behaviour. The former was presented and played at the NordiCHI conference 2022, the latter was used in several workshops, including one for DIKU teachers led by co-creator Donna Hurford (SDU). At the time of writing, DOREEN is in the process of being turned into a card game in German, becoming part of the syllabus of a first-year course for over 500 computer science students at TU Wien, thanks to informatics Professor Peter Purgathofer whom I met during my research stay in Vienna.

[6] This work was part of my participation in a broader network across Danish universities, the Bias Aware Teaching and Learning Special Interest Group (BATL SIG) within the Danish Network for Educational Development in Higher Education.

In the final meeting with DIKU management to evaluate my role as Diversity chair, a manager noted that the fact that this process of noticing, documenting and negotiating was embedded in the institution made the difference, explaining how a short DEI report made by an external consultant previously did not result in any practical change.

5. Discussion & Conclusions

The cases above provide practical examples of enacting ongoing formative critique. Building on feminist technology studies, our work generated new, collaborative ways to highlight the way sociocultural power differentials and identities are entangled with the epistemic and social practices of engineering and computing (Faulkner 2009; 2001; Riley 2017; Margolis and Fisher 2002; L. Suchman 2002). They show the significance of ongoing and formative points of intervention, with practices of noticing as starting points for our work. This is seen, for example, in noticing metaphors in Samantha's case. In Valeria's case, her work started from practices of noticing by Pernille, but then noticing the everyday practices embedded in objects such as the songbook and porn toilet provided material focal points for documenting and negotiating. These practices of noticing were not a one-time event, but rather ongoing, repeated, and distributed. We noticed many things at many times and involving many people. We built on others' noticing and others' work for institutional change.

At the same time, the above shows how emotions can be significant as emotions "move subjects, and stick them together"(Ahmed 2014, 170), as well as how we navigate them in our work. The choice to pursue metaphors as a focus point in Samantha's first example was, for instance, a strategic decision about what kinds of foci could have an impact, but were not overly tension-filled and so could be worked with productively. It was part of also noticing team dynamics and tensions and navigating within those. In Valeria's case, the initial focus of the songbook entailed noticing how it connected with discourses and practices, including in material and digital objects and infrastructures. The dissemination of Valeria's first paper on stereotyped narratives generated anger and surprise among some employees, which in turn resulted in removing the heterosexist décor of "porn toilet".

In both cases, noticing interwove with documenting. In Samantha's second example, anthropological observations combined with Diana and Alex's existing practices of noticing to offer an additional perspective and help conceptualize the value of experience as a form of knowledge. We built additional forms of noticing and documenting for the publication, where, for example, Diana mapped the allocation of courses to teachers, which highlighted how zero white men had taught required justice-related courses, which concomitantly were seen as less prestigious in engineering knowledge hierarchies (Chen, Mejia, and Breslin 2019, 331). Valeria's work documenting the contents, connections, and effects of the songbook and forms of humour expanded to further noticing and documentation around accessibility and tracing the network of responsibilities in the department and university to make change. This documentation as part of ongoing formative critique also produced evidence of the impact of anthropological intervention, but we also suggest above ways to systematize and expand this other focus for documentation.

Documenting was an active process. It was intertwined with noticing and negotiating, aligning both with anthropological attention how researchers affect the research they are a part of, and with our approach as feminist scholars where perspectives are situated and engaged. In this sense, the kind of process impact produced through ongoing formative critique cannot be assessed with quantitative measures or benchmarking (hence the focus on the formative). Rather, the impact is seen in shifts in the organizational awareness around structural dynamics of marginalization across discursive to social and spatial practices. It is seen in the blossoming of new norm-creative practices and reflections – at the individual, interpersonal and institutional level. Valeria, for example, discusses how noticing and asking prompted others to reflect on and make change, such as procedures for documenting and archiving reports of sexual harassment and discrimination.

Our fieldnotes, interviews, discussions, meetings, and experiences further became crystallized in publications as a form of documentation. As mentioned, publications have a weight in academic settings. In both our cases, academic dissemination had an activist and interventionist valence too, publicly engaging in a critique of discursive, material and social practices that needed to be revisited. Documenting can also take a more playful shape and be crystallized in forms that allow for different types of interaction, like in Valeria and her colleagues' game of provocations DOREEN (and its Viennese translation). Also, in both our cases, this involved negotiating with a variety of actors (grant team members including both deans and professors, members of the wider faculty, local administrative staff and those outside our units, and students, to name a few) both in producing the publications and following up on them afterwards. In this sense, publications are a tool, not an end or beginning point.

Our cases highlight how a significant impact of ongoing formative critique is in how it can diffract, which we distinguish from a classic linear model of impact in how it can expand across many different directions; it can fan out and take many shades, like a diffraction. In Samantha's case, the ways that Diana has pursued her work inspired by some of the forms of knowledge making, to then organize workshops, where others may further pursue these insights in new ways represents a clear and successful diffraction of anthropological work through ongoing formative critique. Similarly, in addition to the case of administrators changing their documentation practices, the ways Valeria's work with Inclusive DIKU expanded through sub-groups and through the Science faculty and university, as well as how questions of gender and humour diffracted to questions of accessibility highlight the power of diffractive change. Similarly, the game DOREEN brought the discussion in different settings, in and outside Denmark.

While we have largely highlighted successes above, we have also indicated how this work entails many challenges. Enacting ongoing formative critique can take a personal toll, requiring emotional and mental support. We both faced experiences of heterosexism as women while working in these fields and, through our work, our practices of noticing and documenting also entailed learning about and discussing others' experiences of discrimination and harassment along multiple dimensions. It is important to discuss these challenges in order to enable and sustain such work, also tied to an increasing awareness and discussion in anthropology of the emotional effects of fieldwork (Bosco 2021). Joint problematizations are based on a complex togetherness in which "we understood each other and did not understand each other" (De La Cadena 2021, 248). There are often complex affective dimensions to this. As feminist scholar Sara Ahmed notes, "it is through the effort to transform institutions that we generate knowledge about them"(Ahmed 2017, 93), and this effort is often frustrating and emotional. Ahmed defines feminism as sensational - the process of noticing sexism or racism starts with "sensing" wrongs, which often builds on embodied experiences that make us feel vulnerable – we notice what we have been taught not to notice, and this form of noticing becomes political labour (Ahmed 2017, 32).

Emotional labour is a significant part of navigating the multiple structures, people, and agendas. This often entails strategic decisions about what to pursue – or not to pursue – in terms of enacting change, as discussed by Samantha, while sometimes also facing brick walls as Valeria relates in relation to the Facebook group and Meta, and the multiple layers bureaucracy in addressing the 'porn toilet'. It may also entail working with people who are opposed to DEI work or to anthropological methods, or who simply have not invested much time or thought into it and are not willing to do so. Investing time in this work for us can also present challenges where our futures are tied to hiring and promotion criteria where such "service" work is often devalued (Hanasono et al. 2019). But hope and joy can also be diffractive, particularly when DEI work is done collaboratively -positive emotions are also bound up in feminist action and motivate new work in different directions (Ahmed 2014).

These dynamics all shape the possibilities for and impact of ongoing formative critique, in higher education, but also relevant to DEI work in other organizations. With this in mind, we conclude by summarizing our insights in five actionable steps, to support both anthropologists and organizations who want to include anthropologists as part of implementing change.

Five steps towards productively enacting ongoing formative critique for anthropologists and organizations:

1. **Identify and build systems of support for the anthropologist and DEI work.**

   This can include fellow social scientists or colleagues who have been invested in DEI work within the organization, but should also include forms of institutional and organizational support (e.g. administrative support, funding and official recognition), clarity on role expectations, forms career advancement, as well as resources for supporting mental health. There is a need to acknowledge the role that emotions play in processes of organizational impact, both on the individuals and in creating change.

2. **Establish committees or networks for collaboratively enacting DEI work.**

   Anthropologists are not magic bullets and change cannot be done by one person. In addition to systems of support, networks of allies/colleagues/comrades are all needed in order to put in the work of enacting change – of tracing the networks of responsibilities, of taking on the task of modifying ones' language, of following up on requests, and so on. There is a greater potential for diffractive effects with collaborative involvement, as others take responsibility for this work and enacting change.

3. **Take time to examine and understand.**

   Taking time to understand multiple perspectives of those collaborating on DEI will help make collaborations productive. Many STEM fields are problem-solution oriented, and so there is a balance between enacting change and taking time to set the groundwork for collaboration. This includes understanding each other's vocabularies and perspectives. What is change? Is it a project or an intervention? Establish a shared (or mutually understandable) language that is used to discuss and work collaboratively in enacting change.

4. **Discuss and negotiate boundaries and expectations.**

   This includes common anthropological practices of discussing and negotiations when observations can take place and scope of anonymity, for example, but also different expectations around what is imagined in terms of types and forms change. How do different members understand equity or social justice? What is the role of anthropological and qualitative knowledge? This last question can be key where social science knowledge can be devalued as both "soft" and "feminine" in (heterosexist) STEM contexts. Discuss how information will be shared, such as publications or meetings, and how processes can adapt as needed.

5. **Pursue ongoing formative critique towards enacting change.**

   The anthropologist(s) (and others) should use the anthropological toolkit, along with resources from other relevant disciplines, to notice, document, and negotiate foci and possibilities for enacting ongoing formative critique. Follow up on activities through interviews, surveys,

observations and other methods of documentation. This process should interact with points 3 & 4 above where the process is supported by an organizational structure, established in 1 & 2. That is, the organizational structures from 1 & 2 are a means of providing venues for formative engagement with relevant other allies/stakeholders/colleagues and leaders, and ideally lead to processes of both learning, action, and documentation and diffractive change. New discussions should emerge that need to be examined, understood, and negotiated in steps 3 & 4 based on practices of noticing and documenting.

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PAPER 2

Computer Supported Cooperative Work (CSCW) (2022) 31:771–803
https://doi.org/10.1007/s10606-022-09440-9

ECSCW CONTRIBUTION

Humor and Stereotypes in Computing: An Equity-focused Approach to Institutional Accountability

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Accepted: 27 June 2022

Abstract. We propose equity-focused institutional accountability as a set of principles to organize equity, inclusion, and diversity efforts in computer science organizations. Structural inequity and lack of representation of marginalized identities in computing are increasingly in focus in CSCW research – and research institutions as well as tech organizations are struggling to find ways to advance inclusion and create more equitable environments. We study humor in a computer science organization to explore and decode how negative stereotypes create unnecessary and avoidable barriers to inclusion and counter efforts to creating a welcoming environment for all. We examine the humor embedded in sociomaterial artefacts, rituals, and traditions, and uncover the stereotyped narratives which are reproduced in formal and informal spaces. We argue that these stereotyped narratives both pose a risk of activating stereotype threat in members of marginalized groups, and of normalizing and reproducing ideas of who belongs in computer science. We situate and discuss the complexity of institutional accountability in the context of a traditionally participatory and collegial model of governance. As a way forward we propose three principles for an equity-focused approach to accountability in computer science organizations: 1) Examine organizational traditions and spaces to critically evaluate challenges for inclusion; 2) Normalize critical reflection in the core practices of the organization; 3) Diversify and improve data collection.

Keywords: Stereotype threat, Equity in computing, Diversity, Humor, Jokes, Parody, Gender, Race, Sociomaterial artefacts, Institutional accountability, Traditions and rituals, Filks

1 Introduction

CSCW scholars have been investigating the underlying structures which have produced technology development as a field and profession with a narrow set of narratives and ideological resources (Turner 2009; Ames 2019) – leaving out and devaluing alternative narratives (Irani 2019; Sun et al. 2015). Research has demonstrated not only how technology is actively producing conditions which constrain and re-produce problematic societal inequalities e.g., in respect to race

(Benjamin 2019; Noble 2018), but also how embracing critical paradigms highlighting systems of power in computing will actively produce better and more inclusive technology designs (Spiel et al. 2020). The increased interest in unpacking racialized and gendered agendas of computing has in the last few years made important contributions to CSCW (Ogbonnaya-Ogburu et al. 2020). It is vital that we include marginalized researchers into CSCW academic discussions as well as marginalized user-groups into technology design research to ensure that we do not miss important voices and perspectives (Tuli et al. 2020). In recent years, we have witnessed an increasing number of CSCW scholars who center non-Western or non-white perspectives and contexts into their research (Boulus-Rødje 2018; Bjørn and Boulus-Rødje, 2018; Wulf et al. 2013a, b; Bardzell et al. 2017; Boulus-Rødje and Bjørn 2021; Lindtner et al. 2014; Martin et al. 2016; Jensen et al. 2022; Harrington et al. 2019). This stream of research establishes the fact that we are missing equity in terms of access and representation in technology design and development (Harrington and Dillahunt 2021; Menendez-Blanco et al. 2018) in the workplace (Albusays et al. 2021) as well as in educational settings (Borsotti 2018).

As researchers invested in both understanding and actively challenging inequity in computing, we examine the elusive challenges to inclusion and equity in a Computer Science department in Denmark. It is important to state that the department has initiated several initiatives towards gender diversity since 2016 and managed to increase the percentage of women students in the bachelor programs from approximately 8% before 2015 to approximately 20% in 2021. However, elusive challenges continue to exist and we must understand these challenges to be able to act and improve our department and successfully develop an equitable environment for all.

One of the elusive challenges we discovered was the ways in which stereotyped narratives surface in the departmental enactment of humor and jokes embedded into traditional institutional practices and everyday interactions. We decided to turn our attention to these traditions of humor and jokes to unpack the stereotyped narratives and explore the complexity of institutional accountability as related to equity.

We ask the following two research questions: 1) Which stereotyped narratives emerge from traditions of humor in computing, and 2) What are the challenges these raises for the institutional response and accountability where they are produced?

We studied traditions and rituals of humor and jokes through artefacts, ethnographic studies, observations, and interviews. Based upon this material we identified three strands of emerging stereotyped narratives which we trace in both formal and informal educational contexts. We reflect upon our findings in relation to the concept of stereotype threat (Aronson et al. 1998) and discuss the complexity of taking appropriate action giving the contextual circumstances. We propose

equity-focused accountability as an analytical strategy assisting organizations in critical reflections upon equity challenges related to historic traditions and rituals, and ways to address the complexity of balancing participatory engagement and inclusive efforts.

The paper is structured as follows: First we situate our research in prior work on the social and ethical dimensions of humor; on stereotyped narratives in computing and within the conceptual framework of stereotype threat. Then we introduce our methods, data sources, data collection methods, as well as our data analysis methodology. This is followed by a result section, structured in two main parts. First, we present the results of our analysis of the stereotyped narratives emerging from the empirical material examined. Second, we discuss current challenges for institutional accountability by contextualizing the computing department in focus, including its tradition of student participation in shaping social activities and in decision-making processes at the university. In the discussion, we reflect our empirical findings in relation to prior work on stereotype threat and humor and propose an equity-focused approach to institutional accountability related in three principles. Finally, we conclude the paper.

2 Background: humor & stereotype threat

To be able to explore the nature of the stereotyped narratives emerging from traditions of humor in computing, we need to first understand the multifaceted ethical, social, and cognitive dimensions of humor. To do so, in this section we start by highlighting relevant literature describing the role of humor in expanding human knowledge; the ways it shapes and it is shaped by social contexts and dynamics, as well as studies discussing ethical considerations on how specific types of humor can amplify stereotyped narratives and thus might counter efforts of creating more inclusive and welcoming environments for all. The concept of stereotype threat can help us to better understand this risk – especially to understand how historically constructed narratives might negatively impact underrepresented groups and contribute to normalizing and reproducing ideas of who belongs in computer science, raising concrete challenges for institutional accountability. We also review literature specifically analyzing the historical construction and social impact of biased narratives in computing and technology development, both in education and in the industry.

2.1 Humor, parody and jokes

Literary theorist Mikhail Bakthin – who wrote extensively on parody, humor and satire—argues that laughter frees human imagination and opens up for new ways to imagine what is possible (Bakthin 1984). Humor can open up to new ways of seeing and decoding the world. Humor expands human understanding, allowing

us to perceive a situation from multiple points of view (Hsu 2016). Humor allows us to consider the 'unknowable' in a situation and thus "reveal the known that cannot be said" (Hsu 2016, p. 58). The role played by the jester and fools at the royal courts in presenting their perceptions in clever and humorous ways after having observed from their peripheral position in society was important (Otto, 2001). Fools would be expected to tell the truth but in a way which allowed the privileged powerful (like kings or emperors) to consider multiple perspectives before making decisions. Jokes and parody invite playfulness and exploration as a mean of inquiry into specific phenomena, which otherwise would be difficult (in some cases maybe even impossible) to address directly. Parody can be an effective tool in interventionist strategies: Fox, Lampe, and Rosner use design parody to open up for new ways to engage with issues of social justice, creating design interventions to elicit reflection on themes of equity (Fox et al. 2018).

Social anthropologists have analyzed how jokes and humor shape—and are shaped by—power relations. Jokes can play a role in supporting and maintaining social roles and dynamics, as in the case of standardized "joking relationships" defined as relations in which one is permitted, or even customarily required, to make fun of another with no retaliation, in a "combination of friendliness and antagonism" (Radcliffe-Brown 1940, p. 196). Mary Douglas observes that "the social dimension enters at all levels into the perception of a joke" (Douglas 1968, p. 365), and that social control shapes which jokes are valued and permitted, typically on behalf of specific values and hierarchies. Jokes can denigrate and devalue dominant values – subverting hierarchies and establishing unofficial values (Douglas 1968). Jokes and humor can build community and social cohesion. In her study of hacking culture, Gabriella Coleman reflects on the cultural peculiarity of hacker humor, in some cases deliberately esoteric (meant to be understood by few) to create in-group membership: "Like many instances of joking, hacker humor is so culturally coded (which here means technically inflected) that the only people who can routinely receive, and as such appreciate, their wit, are other hackers" (Coleman 2012, p. 104–105). The esoteric features act as a reference key which can expose outsiders (Lundbjerg et al. 2017; Bjørn and Rosner 2021). Implicit referencing is a part of the computing culture cemented by the practice of 'easter egg' where programmers hardcode their name or other features into digital technologies (Bjørn and Rosner 2021). Only real insiders can find the easter eggs and thus crack the cultural code – as the protagonist Wade in the cult science fiction book and movie Ready Player One (Cline 2011). Further, humor can also be used to build community around an appreciation for being ridiculed by others, reframing inappropriate behavior as acceptable and funny (Allison et al. 2019).

What counts as 'good' humor is connected to the social milieu and background and differs between groups, people, situations, and moments in time (Kuipers 2015). Satire and humor might embed abusive or stereotyping elements,

raising ethical questions. Freud distinguishes between non-tendentious humor, which manifest in clean jokes, puns and wordplay, and tendentious humor, which contain lust (dirty jokes) or hostility towards specific groups of people (ethnic jokes) or both (Freud 1963). Researchers studying the ethics of humor have long debated on moral positioning towards tendentious jokes. Some, like Rappaport, contend that laughing at ethnic jokes does not necessarily mean taking a moral stance, or buying into discriminatory beliefs (Rappoport 2005), because humor works as a suspension of belief.

Other contend that tendentious jokes are harmful because they reproduce and amplify existing prejudices "for fun" without letting them really be questioned (Bergmann 1986). Philips stresses that in the context of the power unbalances and structural inequity characterizing our society, ethnic jokes are not only harmful but divisive, because they can create social dynamics in which people failing to laugh at the joke are seen as outsiders (Philips 1984). Psychological research into sexist humor – the type of humor that stereotypes and denigrate people based on their sex or gender – validates the perspectives of those who correlate ethnic jokes with negative social outcomes: Sexist humor can have negative effects on people's perception of others based on their gender, and on their willingness to discriminate (Ford et al. 2008, 2015). Thus, the consequences of sexist humor can have direct effect on how the target group perceive themselves in the social setting where the humor is produced. Specifically, the self-objectification produced through humor can narrow target groups own self-perception and risk occupying cognitive resources and thus reducing available resources for processing interactions or new information (Ford et al 2015, p. 265). Thus, college traditions of humor risk alienating students from historically underrepresented groups by marginalizing them (Van Jura 2010), for instance when derogatory humor, harmful narratives and stereotypes become part of institutionalized rituals and social practices.

2.2 **Stereotyped narratives & stereotype threat in computing**

In the early 1990s Wajcman contended that "technical competence is central to the dominant cultural idea of masculinity, and its absence [is] a key feature of stereotyped femininity" (Wajcman 1991, p. 159). The construction of this stereotyped narrative has a recent history and stems from biased institutional practices and structural gender inequity. Historian of technology Mar Hicks explores how the top-down structural discrimination and devaluation of women's skills and abilities in British computing contributed to the construction of the narrative of women as less technically competent. In the late 60 s, computer marketing campaigns in the UK often relied on images of sexually attractive young women to sell the idea that using the computing system would require low skills and cheap labor – both exemplified in the recurrent image of the young female clerical worker (Hicks 2017). Ensmenger documents how aptitude tests and personality

types developed to hire programmers by US companies in the 50 s and 60 s "created a gender-biased feedback circle that ultimately selected for programmers with stereotypically masculine characteristics" (Ensmenger 2010, p. 78) excluding many potential female candidates and creating the foundation for "the establishment of a highly masculine programming subculture" (Ensmenger 2010, p. 79).

Stereotyped narratives about computer scientists are pervasive, particularly in the US and Europe, and they can have negative effects on both broadening participation in computing education and on the sense of belonging of those who do not conform to the perceived norm (Margolis and Fischer 2002; Cheryan et al. 2015). According to the "geek mythology", the archetypal computer science students is a white male geek whose life revolves around computers so much so that he is "dreaming in code" (Margolis and Fisher 2002). Data from studies on media representations of computer scientists suggest that the dominant stereotype is that of a male computer genius lacking social skills – a stereotype which is incompatible with common perceptions of the female gender role (Cheryan et al. 2013). There has been a significant amount of research on how such gendered and racialized stereotyped narratives produce negative outcomes on an individual and societal level. The presence of stereotypical cues in computing study environments can negatively impact the sense of belonging by underrepresented groups in those contexts (Cheryan et al. 2009). Sexism and devaluing attitudes towards underrepresented groups in computing have negative impact on targeted students, their well-being and their persistence (McGrath Cohoon et al. 2009; Rankin et al. 2021; Cain and Trauth 2013). The interplay of structural barriers and stereotyped belief systems about abilities and "natural" preferences in turn inform new stereotyped narratives and assumptions about who is most likely to succeed in computing (Margolis 2008). In the professional domain of global software development, widespread essentializing stereotypes along cultural and ethnic lines—and concurrent efforts to actively challenge them and attend to them—have been recently documented (Matthiesen et al. 2020). While clear stereotypes exist within computing education as well as in the professional domain of computing, it is important to understand the impact and consequences such stereotypes have for underrepresented groups – and for that we turn to the concept of stereotype threat.

Stereotype threat describes situations where a person's awareness of negative stereotyping related to their social group causes increased stress and impair their performance due to the awareness that they might be judged in accordance with a negative stereotype (Aronson et al. 1998, Steele et al. 2002). Aronson et al. (1998, p. 86) conceptualize stereotype threat as a situational pressure and not as evidence that the target person accept the stereotype. They explain: "targets need not see the stereotype as valid in order to experience stereotype threat. Mere awareness of the stereotype and its alleged relevance to one's performance in a

given situation is sufficient" (Ibid, p. 86). Further, Aronson et al. argues that "stereotype threat is likely to have its strongest effects among those who are least likely to internalize or accept the stereotype—those who are heavily invested in the domain. Those who are most invested—most "identified"- are also most likely to be concerned about poor performance in the domain" (Ibid, p. 86). This means that underrepresented groups in computing, when encountering stereotyped narratives, might experience more pressure and anxiety, risking internalizing stereotype-related doubts about their abilities. Finally, stereotype threat risk that underrepresented groups disidentify and disengage with the field and domain. *Disengagement* is a coping mechanism, where underrepresented groups experiencing negative stereotypes to maintain self-esteem walk away from the domain when success seams elusive and there is an unpleasant struggle to succeed (Aronson et al. 1998). The concept of disengagement based upon stereotype threat thus point us to the concrete risk of alienating and losing qualified members of underrepresented groups within the computing domain, thus disrupting current institutional efforts to truly increase participation and foster inclusivity.

When we in this paper ask which *stereotyped narratives emerge from traditions of humor in computing, and what are the challenges these raises for the institutional response and accountability where they are produced;* we need to explore the ways in which traditions and rituals of humor risk iteratively re-producing negative stereotypes of underrepresented groups in computing and identify new strategies for inclusivity.

3 Method

To explore the stereotyped narratives emerging from traditions of humor in computing, we conducted an in-depth qualitative study on how humor is produced and enacted in the traditions and rituals of a department of computer science at a large Danish University. Our overall research approach is interventionist by nature (Zuiderent-Jerak 2010; Zuiderent-Jerak and Jensen 2007), in that we both study and qualitatively explore our area of concern (humor in computing traditions and rituals) while using the insights to make change and execute interventions (Bjørn and Boulus 2011; Mumford 2001). We examine our own institution as we are actively involved in diversity and inclusion service work within our organization. While we focus locally on a specific department of computer science, our results echo a much larger concern for the computing community (Margolis and Fischer 2002). Thus, by unpacking the traditions of humor in the specific department from the vantage point of our own situated position, we also speak to larger concerns in computing.

We identify and analyze the sociomaterial practices and artefacts as they are performed and enacted within the environment (Bjørn and Østerlund 2014).

In our work we refer to artefacts as meaning-making devices, which organize the mutual engagements between cooperative actors (Bjørn and Hertzum 2011; Hertzum 1999; Schmidt and Wagner 2004). Through interaction with artefacts, meaning circulates and is reproduced. Artefacts bear traces of past traditions, manifest norms and values, and current traditions and social practices. In this way, analyzing artefacts allows us to capture often overlooked traditions and organizational practices – and highlight how biased humor can manifest itself. We use the multi-sited CSCW approach (Blomberg and Karasti 2013; Bjørn and Boulus-Rødje 2015), which is inspired by anthropological re-conceptualizations of ethnography as a strategy for understanding places and people through knowledge emerging from different intersecting social and political locations (Gupta and Ferguson 1977; Marcus 1995). In this paper, we designed the multi-sited space of research by following strands of humor as they are encoded in spaces, artefacts, and sociomaterial practices. As it has increasingly become the norm for research on inclusion, we choose to self-disclose our intuitional and academical positioning in this research. Being part of the organization – acting respectively as PhD student and diversity chair and as full professor and deputy head of department for research – makes the research effort of conducting such a qualitative study something delicate, as the humor in historic rituals and traditions can be difficult to tackle institutionally and present a risk of jeopardizing important relations across students, faculty, and staff. Something we by no means have as our intention. Therefore, spending some efforts in explicating the methodological reflections which we bring to this work is important (Bjørn and Boulus 2011). First, it is important to state that we find the creative and engaging participation of students in the department critically important and strongly believe this is something we need to nourish and support. Second, we as the main drivers of inclusive efforts in the department since 2016 have come to notice how stereotyped and tendentious humor risks countering our efforts, and thus we need to find ways to approach this difficult subject. Third, we do like to laugh and are not against having fun. However, if we do not address the excluding dynamics embedded in traditions and rituals, we risk, as a department, to lose creative and clever people who otherwise would have become excellent computer scientists. While the department has taken major steps towards inclusion in the last five years, we can still learn and improve. Sometimes this requires us to address difficult subjects head-on, rather than shy away from controversies. We are very privileged to be in a department which allow us to research such topics and views the results as opportunities to grow and improve. We are also very aware that this is not the case for many, and we hope that other computing contexts would view the braveness of our institution and follow by example. We hope this research will not only help our diversity efforts locally – but also have a larger impact in the computing community both nationally and internationally.

3.1 **Empirical context**

Successful and systematic research-based equity initiatives in computing institutions are few, and they are mostly not European-based (Alvarado and Dodds 2010; Margolis and Fischer 2002). While we can be inspired by initiatives such as those implemented at CMU (Frieze and Quesenberry 2015) in the US, we must also pay attention and unpack the specific nature of equity challenges and efforts as they emerge in the contextual setting we want to transform. For example, online sexual harassment in workplaces in Brazil is contextualized differently than it would emerge in e.g., Denmark or France (Tenório and Bjørn 2019).

Our work took place in Denmark, a Scandinavian country known as highly egalitarian, providing universal healthcare and equal right to free education. It might come as a surprise, but Denmark is *only* no. 29 on the World Economic Forum Global Gender Gap Index (World Economic Forum 2021), where all other Nordic countries consistently score at the very top of the list. Less surprising is that the gender disparity within computing is high in Denmark, like other Western countries (Borsotti 2018) with men being overrepresented in the field. Clear data on the intersection between gender (in non-binary terms), ethnicity and social economic status is not officially available in Denmark. Thus, while we are aware that understanding equity in our department cannot only be captured by a gender perspective, but instead is produced in intersectional relationships (Crenshaw 2018) our attempt so far has focused on gender.

The computer science department where we conducted the study was established in 1970 and was the first department of computer science in Denmark, with Professor Peter Naur appointed as the first chair in Computer Science – or "Datalogy" as it was named from the beginning in the Danish context (*datalogi*). From the very start, Naur established an environment based on democratic collaboration across functions and roles and "invited teachers, administrative staff and a number of students to take part in an open discussion of the theme "what do we think is essential for the institute we are about to create?" (Sveinsdottir and Frøkjær 1988). At the time of writing, the department has approximately 160 academic employees (faculty full professors, associate professor, assistant professors, post.docs, external lectures, and PhD students) and just under 1200 students enrolled in three study programs (Computer Science Bachelor and Master program; Computer Science and Economy Bachelor program; Machine Learning and Data Science Bachelor program). Besides these programs, the department is also part of interdisciplinary computer science programs with the Department of Communication, the Department of Health sciences, and is currently in the process of developing additional interdisciplinary programs across the university. The department has had a huge growth in the last five years and continues to play an important role in bringing computing research across the whole university both in terms of teaching and research. In this time of growth, new types of initiatives have been created to work actively with diversity and inclusion (Bjørn

and Menendez-Blanco 2019; Menendez-Blanco et al. 2018), and there have been an increase in the participation of women in the bachelor programs (from approx. 8% women in the whole bachelor program prior to 2015 to 17–20% women being accepted each year since 2016) as well as in the faculty hiring (the first woman full professor was hired in 2015 and now there are four—three full time—women full professors in 2021). Thus, we have witnessed much progress, but there is still work to be done – especially when we expand our focus to look beyond gender (binary) statistics and focus on exploring organizational cultures and traditions. In recent years the department has witnessed an increase in international faculty and PhD students. It is hoped that this research will contribute to a better understanding of the importance of considering how biased and inappropriate humor might affect the experience of both staff and students in diverse cultural contexts.

Humor and jokes have long been crucial components in the social fabric of the department, as they are part of well-established university traditions for computing departments internationally. MIT has a long-standing "hacking" tradition of designing and implementing pranks, tricks, and clever inventions (Peterson 2003), and computing departments in the US, UK, Australia, and Denmark often feature their own student-driven satirical musical theatre shows. There are long traditions for playful activities during orientation weeks for new students, and clearly humor and jokes embedded in traditional practices help creating communities and sense of belonging. Satirical songs and theatre productions become the medium through which students embed, re-create, reproduce, or challenge norms, traditions, values, and narratives – and pass that on to the next generation. Computing "filks"—humorous computing parody songs – have been crafted for decades in and outside of university settings and have a dedicated audience. Recently, filks have been celebrated for their potential to bring fun into teaching computing (Virtue et al. 2018). To study the humor in the department, we have particularly explored artefacts and rituals in which it is manifested.

As most of our research took place during intermittent lockdowns due to the COVID-19 pandemic, we started our inquiry by focusing on sociotechnical artefacts as a pragmatic way to address our research questions. What stereotyped narratives could we find, couched in humor, in some of the institutional artefacts and spaces – analog and digital – typically encountered by our students? We took our point of departure from what might seem an unusual item: the "Computer Science Songbook" created and edited by computer science bachelor students at the department. The songbook exists as both a physical book, printed on paper and as a digital artefact on GitHub. What makes the songbook particularly relevant is that it is used during an important transitional phase and ritual in the academic socialization of computer science students: The orientation week and freshers' trip activities—and it stands at the intersection of two well-established collective social traditions of humor at the department: Group-singing (which takes place during the orientation weeks, where students sing some songs from the book)

and the satirical musical theatre, in Danish *Revy*, which takes place yearly at the Department. Many of the songs in the book are "filks" and parody songs which were originally created and performed as part of the yearly Revy shows.

3.2 **Data sources**

One of our main data sources is an artefact: In this paper we analyze the 2019 edition of the Computer Science Songbook which was used by bachelor students during the last *freshers' trip* before the Covid-19 pandemic. The book is sponsored by the Danish Society of Engineers, and is also available as a PDF file. The first historic songbook was created in the early 70 s and has been reproduced, extended, and modified over the years.

Moreover, to better understand the socio-historical context in which the songbook has been created, we have conducted eight semi-structured interviews: We interviewed six students – ranging from alumni from the 70 s and current students – and two staff members at the university. Interviews have been conducted and recorded by the first author, who has full access to the names of the people interviewed and the interviews transcripts. All the interviewees in this study had a relation to the group singing tradition as either authors, composers, editors or audiences to the songs. However, to ensure confidentiality we cannot specifically state, when presenting a quote, the relation of the interviewee to the songbook.

In addition, we collected data on the department's sociomaterial practices through field notes, informal conversations, observations in formal and informal spaces and participation in events (such as two seminars on sexual harassment organized by the university), and we draw on our own experience as researchers involved with diversity and inclusion service work at the department.

Exploring the nature of the *stereotyped narratives which emerge from traditions of humor in computing* as they are embedded within the songbook, we identified a general classification of the songs. The digital and analog songbook includes 146 songs, plus one extra text. Almost all the songs, except for 25, are from the university Revy theatre shows. Most of these songs – 78 in all—are from the Computer Science department's own musical theatre. Most of the songs center around computing education, mostly focusing on programming and the academic and social life on campus. Other themes are explored, including bureaucracy, inefficient IT systems, working in IT or global software development. Many of the songs are authored by students of other departments for their theatre shows (Math and Physics) – showing a strong dynamic connection between student traditions across departments. This connection is worth noting, as many of the students might major in Computer science with a minor in Math, or major in Math with a minor in Computer science. The oldest student-authored song in the 2019 songbook is from the 1992 – but most of the songs written by students span from 2000 to 2014. Songs from the musical theatre include a note on which melody should accompany the lyrics, as they are either parodies or a

pastiche (in literature usage: a playful imitation) of well-known songs. Songs to be sung during the freshers' trip are typically chosen with a roll of dice.

3.3 **Data analysis**

To analyze our data, we applied both deductive and inductive coding: We adopted *qualitative content analysis* (Bernard 2002), to identify whether and how stereotyped and normative themes and narratives identified in literature occur in the empirical data (deductive coding), and *grounded theory* (Strauss and Corbin 1990) to be open and identify new relevant categories and themes emerging from the material analyzed (inductive coding). All the data material was imported into NVivo (version 12) and analyzed iteratively.

To investigate which main narratives are represented in the songbook, we used *text analysis*, a qualitative research method commonly adopted by ethnographers in the study of written texts. To capture subtle figures of speech, we first did a detailed analysis of all the songs, identified a set of themes, selected a series of excerpts and examples, translated them into English and organized them in categories. We then transferred all texts in NVivo, which served as a tool to easily navigate data. The whole process was accompanied by writing memos—taking running notes on the themes and how they were interrelated.

Through our analysis, we first identified a set of stereotyped narratives surfacing in the humor produced and re-produced through artefacts, spaces, and social practices at the computer science department, and which we grouped thematically in three main categories: 1) Gendered stereotypes of nerds and hackers; 2) Stereotyped representation of women; 3) Stereotypes on techno-capitalism and race in global software development. We will explore each thematic category in the first part of the Results section. Second, our empirical investigation highlighted some of the challenges for institutional accountability raised by stereotypical narratives in computing. We will present them in the second part of the Results section. It is important to notice that throughout the whole research process we have been in dialogue and discussion with the administration and management of the department to find ways to bring in our insights back to the department with the aim of taking action.

4 Results

In the below section, we provide empirical data which includes sexist, transphobic, and racist statements. We choose to display snippets of the data to be able to explicitly address the problems so that we as part of the institution can learn and reflect – and thus improve the practices. We believe that only by addressing what is difficult explicitly are we able to reflect and make interventions and change. We apologize in advance for the offensive statements.

4.1 Stereotyped narratives embedded in social practices, spaces and artefacts

4.1.1 Gendered stereotypes of computer geeks

As displayed in the 1980-ties pop culture movies such as 'Weird Science' from 1985 and 'War Games' from 1983 the science geek with a computer can do anything from literally build their own romantic partner to save the Earth from nuclear war by teaching powerful computers the concept of mutual assured destruction through playing tic-tac-toe. Computing geniuses in both movies end up using their computer powers to make impressive actions and reflect the stereotypical narrative of the computer geek as a masculine white man who spends most of his time alone in the dark in front of a screen hacking or playing videogames.

Not surprisingly, some of the parody lyrics written by students, which are featured in the songbook, weave in the stereotype of the lone person sitting in the dark, drinking cola, and playing games all night, and celebrated it with humor. For example, in the below song written in 2001 which originates from the Physic Revy, the joke is on the geeky computer scientist:

> 'Who is sitting in front of the screen / With Cola in his hand / With pale weak arms / And a body which weighs a ton/ It's the computer scientist / A nerd, that's for sure / With caffeine in his blood and cybersex at the ready.'

Rather than shying away from the societal stereotype, several songs in the songbook jokingly reappropriate the geek stereotype and embrace it proudly. Songs often quote classic geek fandom references such as games, movies comics and books. As the above example illustrates, some of the songs about geeks which are now part of the book's repertoire come from other departments' satirical theatre shows, such as Math or Physics. This is interesting because it illustrates how stereotypes are pervasive in and outside computer science educational programs, and how teasing others based on group stereotypes is a common social dynamic – which, in the case of computer science and close disciplinary fields like Math and Physic, can be a way to establish friendly and antagonistic group boundaries. In this example, and in other songs portraying geeks, the ironic use of the geek stereotype and its reappropriation can be employed to define and reaffirm group identity positively by reclaiming the stereotype.

In the students' songbook, the stereotypical geek is typically gendered as masculine, however we found one clever example on lyrics which try to counter the gendered nature of the geek. The parody "Let it Grow – Duet Between Two Female Computer Scientists" is authored by two women students who wrote the song for the 2014 Computer Science Revy, and we have later learned that the theme of the song emerged as a reflection that the only difference between students, for some, were their ability to grow or not grow a beard. The song illustrates the acute awareness of the presence of stereotypical and sexist assumptions

which are displayed in computing, but uses humor to expose and challenge prejudiced narratives. One the lines: “Let them just stare” demonstrates the experience of being visible *in a different way* as a woman in computing, but in the parody the “staring” is embraced and welcome after they attach masculine beards to their bodies. The song exposes and pushes against sexist narratives linking gender to specific assumedly innate attributes such as technical skills (or lack thereof) and makes a playful reference to the binary (in gender and computing) with the use of 0 and 1 in the text:

> ‘1: You’re hoping to be a real computer scientist / 0: I’ve tried everything / But it will not grow
> 0: It cannot ’happen, I’m a girl’ / 1: That’s what all people will say /0: But the dream won’t go away. Give me a beard! Let it grow Let it grow (…)
> 1: Without a beard, the days of a computer scientist are numbered / 1: Your female sex dictates
> All that your body can’t do / 0: But it’s hard to accept all I cannot get (....) 0 + 1: With our beards we can handle everything / Let them just stare / Without a beard, the days of a computer scientist are numbered’

In the YouTube video showcasing the original performance of the song during the computer science Revy, props on stage include a poster featuring photos of bearded computer science teachers at the department, past and current, as well as images of Ada Lovelace and Grace Hopper donning fake beards. In this way the song both affirms and challenges the gendered stereotypes of geeks and hackers. Further, the melody of the song is “Let it go” from the movie “Frozen”, confirming the focus on transformation – of producing a new, queer computer scientist entity which blends across genders. While this parody is challenging and *queering* assumedly innate gender distinctions, opening up to other gender possibilities beyond the binary (“with our beards we can handle everything”) – it still clearly condemns the narrative naturally linking computer science to a masculine undertakement.

4.1.2 Stereotyped representation of women

While the abovementioned song clearly was a clever humorous way of parodying the argument linking gender to technical ability in computing by turning it into a discussion on beards, most of the songs which include mentions of women would be of a sexist nature. It is important to mention that the songs in the songbook can be divided into three types of songs: 1) Parody songs written outside the university; 2) Pop/traditional songs written outside the university, and 3) Songs written by students. Sexual objectification of women was a recurrent theme in most songs mentioning women, from either category. Overall, the complete songbook of 146 songs, women and/or girls appear in 26 of the songs (18% of the songs), and in more than half of these songs, women/girls are sexualized (n = 14/26; 54%), and in 5 out of the remaining 12 songs "women” appears as object of

desire. If we try to unpack these songs, there are traditional sea shanties, mock rock comedy songs (both Danish and American) and other traditional lyrics sexualizing women. Examples of these includes Tenacious D's song from 2010 "Fuck her gently" and Onkel Dum & Bananerne song from 1989 "Gætteleg" which is a Danish comedy song referring to oral sex. However, the sexualized humor is not only from adopted songs which have been included in the songbook. Sexualized humor also exists in the songs written by students.

Analyzing the songs written by students we observed that the trope of the "hot" scientist – skilled and sexy, an object of (heterosexual) desire was present. Examples includes a song from the 1998 Computer Science Revy, in which a computer scientist wants to get "close physical contact" to a sexy physics student ("she looks like something you download from the internet"), or a song from the Physics Revy 2015 in which there is a double entendre on women "coding". Further, we also found representations of gender inferiority joking on the fact that women are successful because they receive support and help from male fellow students and lecturers, but also a transphobic joke featuring the "disguised in drag" trope of the man dressed as a woman to mask his technical incompetence and receive help from fellow male students and staff. In this way, the representation of gendered sexuality in the songs is connected to inferiority of non-masculine characteristics of the field of computing – targeting not only women – but also non-binary and transpersons.

The sexualized representation of women as part of the humor and parody displayed in the songbook resurfaced in both online and physical spaces in the educational settings, creating and reproducing exclusionary dynamics and norms. We found that the same tradition of bawdy humor and (hetero)sexual themes present in the songbook were also showcased on campus in the interior decoration of the student-run bar (which is often mentioned in the songs), a popular meeting point for students from Computer Science, Math and Physics and other related disciplines in the Science faculty. The bar interior has been humorously designed with features such as a strip-club pole, and the toilet for people with disabilities is decorated with pictures of naked women and stickers of couples having sex. Young people make up the majority of the students in universities, and most of them are naturally interested and engaged in sexual behavior. The problem is not the sexualized representation per se, but specifically how these instances of humor reaffirming heterosexual masculinity and the sexualization of women are portraying problematic narratives about women and heteronormativity in social spaces on campus. Especially since these narratives are directly connected to narratives about the competences and potential success of students with minority characteristics (e.g., women or transpersons). In tandem with the sexualized narratives, we found that jokes displaying narratives on the technical incompetence of women were profoundly present. Examples includes sexist memes on a Facebook page curated by computer science students, a public group

counting thousands of members, representing women as technically incompetent and inferior to men:

> 'WOMEN PROGRAMMERS? YOU MEAN PROGRAMMING THE DISHWASHER?'

A heated discussion follows in the comments section, where students discussing whether this joke is sexist and inappropriate. A student displays in her comments how jokes like the above make her want to leave the Facebook group altogether. Another recent meme posted in the student-run Facebook meme group is a pun on the objectification of women:

> 'Other: don't treat women like objects. Me: Women women = new Women ( ) ;'

The above memes are good examples of humor supporting a gender normative culture stressing innate capabilities of individuals and minimizing devaluing cultural norms. Besides the informal online and physical spaces like the bar and the Facebook group – the sexist jokes also enter the classroom. During a lecture in a class with more than 100 students in an auditorium, an anonymous student adopted the username "Women Can't Code" during an interactive exercise, with the result that the demeaning message was well visible for the whole auditorium, projected on the big screen. When this happened, a group of students explicitly expressed how such sexist humor was problematic and exclusive. It was discussed in class and the teacher explicitly stated how such behavior was inappropriate. However, the discussion continued in a Facebook group connected to the course – and it was clear that not all students understood why such behavior was problematic – some students continued to minimize the episode and frame the sexist statement as just a joke. This incident demonstrates that sexist jokes or other hateful expressions occurring in social interactions in the classroom might be hard to prevent, and might impact a large number of students and – as in this case, they might occur anonymously and without an easy way to satisfactorily handle and discipline the incident. For this reason, it is crucial that institutions emphasize the goal of actively countering negative stereotypes and sexist representations in institutional contexts where *it can be prevented and regulated*, so that they do not normalize excluding behavior and marginalizing narratives. When new students embark on their education and experience the songbook including the sexist songs, these jokes become normalized and make it difficult for students to determine what is inappropriate in both formal and informal spaces. The sexist jokes connecting gender with skills and competences create narratives about whom can become successful in the field, which again risks alienating and marginalizing gender minorities both socially and professionally.

4.1.3 Stereotypes on techno-capitalism and race in global software development

Programming is an important part of computer science education and profession. Throughout the education, students engage with and learn many different programming languages, and not surprisingly programming languages are also featured in many songs. Concretely, one out of four songs in the songbook features programming as a key theme.

Analyzing the ways in which programming is portrayed across the songs, we notice an emerging pattern which displays the existence of a hierarchy and specific value judgements on programming languages taught in the computer science department. Songs include references to obscure and esoteric programming languages, as shown in the excerpt below, from a 2012 song written by Computer Science students—a pastiche of the Animaniacs theme song where the lyrics are a long list of programing languages:

> '(Brainfuck), Emerald, Unix Shell, Babbage, F, Mouse, Squirrel, Oak, RPL, Legoscript, (Go)diva, Rust, E, Shakespeare, Racket, POP-2, Fjölnir, AutoHotKey, Emacs Lisp.'

In the above song, the very listing of the programing languages is following the melody making the languages by themselves into lyrics. By playing with the grammatical expressions, syntax and semantics, students demonstrate familiarity with the specific nature of the computing languages. Highly valued programming languages include C and C++(the latter created by Bjarne Stroustrup, a Danish computer scientist) and are portrayed as positive, providing connotations that C/C++are the appropriate languages to really master. On the other hand, it is clear from the lyrics across songs that there are programming languages which are viewed as less valuable – and most jokes are on Java and Javascript. These are presented in the parody songs as programming languages developed by the 'greedy' industry whose only interest is earning money. Java is characterized as only used in large software engineering projects in large companies and is frowned upon as the language of "the capital" (alluding to the Marxist meaning of capitalist exploitation of workers).

It is noteworthy to mention that students in this way make political statements founded in the late 60 s-early 70 s university environment in Denmark, a time of uprising when students stood up to transform universities into democratic institutions and to push radical political agendas. So while computer science often is portrayed as an "apolitical" practice, which simply works 'objectively' with data, it is clear that the students through some of their songs, rituals, and traditions express a sharp critique of the tech corporate environment: "the capital"—explicitly providing a narrative about the private sector's exploitation of computer science human labor to earn money, and working in software

engineering is sometimes referred to just as "coding for the capital" (in some cases "coding badly for the capital"). Most of the parody songs focusing on the themes of working in software companies depict the IT industry negatively, and often juxtapose the stimulating complexity of studying computing or working on one's own project – and the "brain gymnastics" involved—with the well paid but boring and unchallenging reality of working in the industry. This narrative continues in the songs bringing in the theme of the global tech industry, and particularly global outsourcing software development. Here the theme of 'coding for the capital' is extended to software developers working from "the East", which can both refer to Eastern Europe as well as Eastern Asia (India, Philippines etc.). Here the themes of exploitation of computer scientists programming for the capital is extended to 'becoming a code slave'. In a song from the 2013 Computer Science Revy, we follow the tale of a Danish "code slave" who loses his job to a "slave coder" in "the East":

> 'Come on, you code slave / your boss is unhappy. Code, you slave, code now / Work all night." (…) "Poor code slave, no more job for you (…) In a dark office in the East sits a computer scientist
> On the wall is a webcam / This is where he now has to live / He earns for the day (…)'

While both the Danish "code slave" and the Eastern "slave coder" are being exploited by the capital, in this song the plot propels a narrative with problematic racist undertones. These racist undertones continue in another Computer Science Revy song, which is a social commentary on software engineering outsourcing in Africa from the point of view of a white "Microsoft evangelist", and in this song racial slurs are used explicitly. The presence of racist slurs and derogatory jokes on specific groups of individuals in an institutional context risks to produce harmful experiences, because it reflects and reproduces discriminatory attitudes and behavior. Since offensive behavior is clearly condemned by the university policies, the presence of slurs in an institutional songbook (written by students) used during orientation week, sends a confusing message to new students about what language and behavior are considered appropriate. Featuring the critique of tech companies' neocolonialism is not problematic per se, and clearly is a theme of importance to the students. However, the critique becomes problematic when embedded in a series of racial slurs or narratives dehumanizing global software developers.

4.2 Current challenges for institutional accountability

4.2.1 Harmonizing long-standing traditions of humor with new diversity & equity efforts

The computer science department we studied was established in the 1970s, which in Denmark was a period of significant cultural shift from the so-called elite

university to the mass university. At that time, the exponential increase of the number of students, the student rebellion in 1968 and the University Act led to a democratization of the governing bodies of Danish universities and an increase in student representation and their influence in boards, associations in creating and organizing social activities. The traditions of group singing during orientation week and during the freshers' trip and the satirical theatre were established at the same time as the scientific department was established, in the early 70 s. Moreover, the students had a huge influence on the development of the department. A computer science student who graduated in that decade explains that sketches from the satirical theatre were part of the students' first social introduction to the department:

> 'I did the freshers' trip in the beginning of the 70s and I did not know a single soul. We were all mixed from different natural science bachelors, not many girls, it was all run by students (…) That was fun, it established some ways into the institute, that you knew someone, so you felt a bit safer... (…) The singing was already an important part (…) And then there was a small theatre group, run by students, who would go around the various freshers' trips with small plays about what it was like being a student and so on.'

Humor and satire played a role in the socialization of students from the department's early days. Students got to know each other and learned about life at the department through humor. The satirical theatre soon became its own entity: Currently the Computer Science Revy is a yearly student-driven production taking place at the university. Satirical songs from the Revy are still an important part of early student socialization. These songs have increasingly filled almost all pages of the songbook, and when used during orientation week, songs are mostly picked randomly by rolling dice, or chosen by student volunteers in charge of the social activities.

Democratic participation is key in processes shaping social life at the university, and students are traditionally represented by councils or associations created to administer different areas. The freshers' trip, the Revy and the songbook are run and coordinated each by their own student council. At the time of writing, the department counts 12 official student councils, organizing anything from LAN-parties to the student-run canteen, ski trips, board games or soccer games. The department has, since 2016, initiated new agendas focusing on students' inclusion and diversity pioneering a variety of initiatives (from recruitment to retention) and a new Dialogue Forum has been established in 2021 to coordinate between students from the Student Council – a union and umbrella organization for all the student councils and administrators. This forum is designed to create a space for discussion and change, among other things with respect to creating more awareness on inclusivity and reflecting on how to activities risk

marginalizing certain student populations. The songbook is in focus as well. A student explains:

> 'There's been a big change towards making sure everybody's included…so students don't feel bad about what's in the songbook.'

When we discussed some of the bawdy pop songs part of the songbook, one of the students explained that these songs have traditionally been part of the repertoire, and as such have been maintained in the book in each new iteration. What is significant here is the weight of old traditions and the complex role they play in any of the newly established commitments to make institutions more open and inclusive. Every few years, few songs are taken out of the songbook by student volunteers and substituted with new ones, typically from Revy shows. The work of maintaining and renewing traditions reveals the complexity of identifying and teasing out what should be included and excluded in the institutional narrative.

4.2.2 **Humor encodes and reproduces values and norms**

The goal of this study was not to measure or systematically evaluate the impact of stereotypes on specific social groups, but to document and analyze how stereotypical narratives manifest themselves in the context of the department, and what challenges these narratives raise for the institution. Our data revealed that traditions of humor are perceived as an important part of the social life at the department, and they can both foster sense of belonging—creating a stronger sense of community—or work as exclusionary mechanisms, reproducing harmful stereotypes and narratives about who belongs in computing. Group singing contributes to student bonding, but significantly also to familiarizing oneself with the department culture, as this student – a man—notes:

> 'These songs are like, what can you compare it with? It's like a football team with...values... you give them along to new members, or something like that. Older students educate the younger students, and when they get old, they're like, moving on these traditions.'

This quote articulates how songs can narratively embed norms and values in the social fabric of the institution. Strong identification with certain traditions is part of any socialization into the academic discourse of specific knowledge areas – and in this process the celebration of the masculine geek stereotype, for instance, or the demeaning jokes on global software developers may reproduce stereotypes (through humor) and shape who is included/excluded in computing, in education and professionally. While the songs clearly are important for the socialization of the students, the narratives expressed in some of them become additional barriers for inclusivity in the department – as in the case, for example,

of lyrics gender- stereotyping women. The below quote by a woman student articulates how the widespread gendered narratives risk impacting how minority students navigate their educational experience. She comments on her reticence to ask questions openly during large courses in the large auditoriums, and her fear to be perceived as incompetent – reconfirming the gendered stereotypes which she encountered in the department:

> 'When you're a male student here, then you just come in and study, you don't have to think about anything else. But typically when you're a female student, you come in, and you also have to think: Am I gonna get judged? I was actually pretty confident before I started studying here, and it has been a battle for me to regain some confidence because... I notice, like, why am I not good enough at speaking up? Why I am not good enough at asking questions? It's a general problem that everybody feels a bit insecure. But it seems like it's even worse for women.'

The gradual decrease in self-confidence experienced throughout her engagement in the education adds an additional burden to her experience. Another woman student we interviewed used the Danish expression "hygge sexism" to explain how, in her experience, sexist comments or behavior (such as microaggressions) risk being normalized in the social interactions in the department, often framed as "just jokes". Through interviews, conversations, and observations we encountered different perceptions of what is considered appropriate as a joke, and in which context. During informal conversations with staff and interviews with students, Danish humor is sometimes framed as slagging—being harsh or insulting but not necessarily with the intention to be abusive. Others see inappropriate jokes as crossing the line, or even shocking, and problematize it, particularly when it targets specific groups of students – particularly minorities in the department.

Our analysis reveals that dealing with problematic and stereotyping humor and its implications, be it reproduced by institutional artefacts such as the songbook or in spaces such as the student-run bar, or in classrooms and other social daily interactions, creates a huge challenge for equity initiatives. A challenge further emphasized by the complexity of uneven regulation and a diffuse lack of knowledge of how to handle abusive language and behavior at the university as a whole. During a (non-mandatory) webinar on sexism and sexual harassment organized by the University and led by an attorney-at-law, with the goal to train staff to become aware of liability issues around offensive behavior, the first author observed that several questions from researchers and staff across different departments in the Faculty of Science revolved around humor. The attorney reported that "offensive behavior in the workplace cannot be excused by humor",

but confusion among the audience seem to be predominant on how to evaluate, as managers or administrators, where to intervene and how.

It is critical to note that strategic work on DEI (diversity, equity, and inclusion) in Danish universities is a quite recent attempt, and generally differs in scope and focus from institution to institution. Denmark does not currently have a set of specific and clear overarching state regulations to support and guide strategic preventive measures and accountability systems for equity and inclusivity in education – nor does it feature official frameworks of accreditation for DEI good practices.

5 Discussion

5.1 Beyond statistics: digging deeper

We set out to investigate which stereotyped narratives emerged from traditions of humor in computing. The results of this study provide evidence that stereotyped narratives along gendered and racial lines exists in the social ecosystem of the computer science institution we studied, and risk creating excluding mechanisms and inequitable outcomes – going against current diversity efforts. This is consistent with prior studies highlighting the prevalence of negative stereotypes in computing and their complex negative social impact (Hicks 2017; Ensmenger 2010; Margolis and Fischer 2002; Margolis 2008). That means that any project pursuing the agenda of broadening participation in computing needs to also pay attention to internal culture – traditions and rituals, to ensure that existing bias and negative narratives – especially when institutionalized – are identified and dealt with constructively.

Humor plays a complex role in articulating, reproducing, challenging and queering stereotyped narratives in organizations. We found that computer science students experience an ecosystem in which stereotypes manifest themselves in institutional and informal contexts, both online and offline (the songbook used during orientation weeks; the décor the student-run bar; the classroom and social media). Humor *is an essential way* to release and exorcise anxiety and worries in the busy life of being a computer science student, humor plays a role in celebrating and defining geekiness (Coleman 2012), maintaining joking relationships across social groups (Radcliffe-Brown 1940) and, in some cases, publicly making feminist statements. This is consistent with recent anthropological research describing humor as an important – and understudied—mode of human cognition (Hsu 2016) which allows people to perceive a situation or phenomenon from multiple diverse perspectives. Existing social relations shape what is accepted as "good" humor (Douglas 1968), and people with different backgrounds or characteristics perceive and experience humor differently, particularly in the case of tendentious humor.

In everyday interactions, humor might be used to minimize or to make sense of excluding behavior, particularly when certain issues are underexamined or stigmatized: like sexist microaggressions on campus, described as manifestations of "hygge sexism" (*hyggesexisme* in Danish) by computer science students, indicating that sexist beliefs or behavior might be couched in humor and/or downplayed as well-intentioned, particularly when students fail to perceive them as harmful. This is consistent with research showing the negative effects of disparaging humor in creating and normalizing inequitable social dynamics (Philips 1984; Ford et al. 2008). Humor can be serious matter: Some women students are coping negatively with the "spotlighting" effect of being perceived as a minority and the pressure to perform to counter negative stereotypical assumptions. These results have important implications, as they corroborate the negative impact of stereotypes reported by previous research. Negative stereotypes might discourage certain groups from participating in computing domains (Cheryan et al. 2013), negatively impact their sense of belonging (Cheryan et al. 2009; Ford et al. 2008). In addition, minority social groups risk activating *stereotype threat* (Cain and Trauth 2013; Aronson et al. 1998), potentially increasing anxiety, self-doubt, and disengagement. This means that, to successfully create strategies to promote equity in organizations so that all talents can thrive, we need to move beyond just collecting statistics and percentages of representation/recruitment/retention of specific social groups and complement those with new ways to investigate and tackle structural and cultural issues that disproportionally affects their everyday experience in our institutions. Statistics cannot capture everything – they are a starting point. The real challenge is to integrate data-driven approaches to diversity and inclusion with different strategies for gaining useful insights on existing cultural norms and social arrangements which might create patterns of exclusion. Basing decision-making on equity issues only on statistics can also concretely pose the risk of losing sights of in-group differences—groups of "minorities" (women, ethnic minorities and so on) become essentialized, and this approach can lead to initiatives that typically do not have an intersectional perspective and fail to capture critical insights.

5.2 **Beyond the pipeline: examining sociomaterial practices**

Socio-cultural challenges to equity efforts can be addressed and can change, albeit slowly. But how? Our work raises the question of how institutions can respond to humor displayed in rituals and traditions and assume their accountability for creating a supportive environment. Negative representations of marginalized identities in computing highlight complex accountability and response challenges – particularly when such representations and narratives are normalized as part of the discursive and material contexts. Sociomaterial artefacts and spaces that make up institutions are not discrete entities; they are intertwined in complex networks of relations which both shape and are shaped by those relations

(Bjørn and Østerlund 2014). The governance of universities in Denmark is both highly hierarchical and at the same time fairly bottom-up and participatory. The academic faculty presents and sets the agenda for research and education, but students are invited into shaping the institutions through student led committees, teaching assistantships, and they are drivers of social events. The department we studied was created in 1970, right in the aftermath of the'68 student uprising when the highly hierarchical professor-rule, shaped by a law which had not been updated since 1788, was replaced by what have been referred to as the most democratic university law, the "University Act" (Styrelsesloven) in 1970, which was amended shortly afterwards in 1973: Both students and technical administrative personal were assigned 25% representation each in all major decisions, reducing the academic faculty to 50% representation, creating the conditions for a new collegial, democratic governance (Rienecker and Li 2015). As a striking example of how exceptional the students' engagement was in the first years of existence of the department of computer science, in 1971 a 25-year-old active student was elected Head of Department (institutbestyrer). This has never happened in any other Danish university before or after. While the university law has been revised several times later – particularly in 1992 and 2003 – giving more modest representation to staff and students in decision-making processes—the importance of student voices and participation remains as an important principle and value in the computer science department formal and informal structure. Thus, there are multiple constellations of both student groups and formal student associations (*foreninger* in Danish) which organize and drive essential culture defining activities in the department such as Facebook groups, student cafés, freshers' rituals, activities, and so on. It is also important to note that boundaries between categories that we sometimes see as clear-cut when looking at organizational structures – like "students", "employed staff"—can be blurry: students often work as TAs, or do paid work running social activities (as mentors). While the students' drive and participation in making the department is valued and important, the organizational setup creates challenges for developing shared cross-functional accountability when it comes to work around issues of inclusion and equity, especially when students, faculty, and staff operate within long-standing cultural traditions – which often reach across other natural science disciplines and their social milieu. It is important to note that the lack of clear and specific state regulations to support and guide preventive measures and accountability systems for equity in higher education further complicates the effective co-creation of long-term and ambitious strategic interventions at a local level. Untangling the complex relations making up socio-cultural ecosystems reveals gaps in accountability that can form the basis of effective interventions – but we hope that our contribution will inspire discussion and action beyond future interventions in single organizations, towards a clearer focus on equity by public agencies regulating the higher education and research sector.

5.3 **Reframing core practices**

Interestingly, from our readings of the songbook as a historic manifestation of the culture in the department, it is clear that the spirit of the '68 students uprising is still present and is in some way aligned with the current increasing recognition of the political nature of computing, which have always been fundamental to CSCW research (Tellioğlu and Wagner 2001; Suchman 1993; Bjørn and Balka 2007; Boulus-Rødje et al. 2015) and especially the European CSCW research (Wulf et al. 2013, b; Stickel et al. 2015; Aal et al. 2014; Wagner 1993). We see this especially in the songs alluding to how working for 'the capital' is viewed as lucrative but less intellectually challenging – and in songs making jokes on specific programming languages for the industry, such as Java. The anti-capitalistic connotations are then connected to controlling ways of working – as in the song 'Who is sitting behind the screen', which also refers, through the chosen melody, to the exploitation of un-named people ('Jens Vejmand') in building infrastructure. However, the way these anti-capitalist narratives are expressed in the songs also show a missed opportunity of connecting with broader feminist critical perspectives which became influential in Danish society right after the student uprising, and with feminist and post-colonial perspectives which today are increasingly shaping current political concerns for technology in CSCW literature (Lazem et al. 2021; Tellioğlu and Wagner 2001; Kristiansen et al. 2018). Students are aware of and critical of the socio-political aspects of global technology development, as it is clear from the social commentaries weaved into some of their songs, but a critical sensibility to the power differentials created along the axes of gender and race is missing. This means that the agenda of furthering more equity in computing, if truly rooted in civic responsibility, should not just be focused on broadening participation to minoritized identities, but can also take the shape of strengthening and reforming the core practices of an organization. This could mean providing current students with the academic skills to better discuss, critically analyse and understand the impact of computing in shaping our future world. This is also consistent with recent calls in the academic computer science community for the need to develop a more critical computer science education "recasting computing itself in moral, ethical and social terms" (Ko et al. 2020).

We propose an equity-focused approach to institutional accountability as a set of principles for how technology institutions can identify and address exclusionary organizational patterns and traditions in an integrated way. First, an equity-focused approach to institutional accountability requires us to examine organizational traditions and social spaces to critically evaluate and challenge narratives and behaviors which might be embedded in institutional practices and have negative impact on marginalized identities. This principle is founded on extensive evidence showing the negative impact of stereotyped narratives and beliefs on the sense of belonging of groups that have been historically underrepresented

in computing (Margolis and Fischer 2002; Margolis 2008; Cheryan et al. 2009); with research showing how tendentious humor can narrow the self-perception of targeted people (Ford et al. 2015) and research linking exposure to group stereotyping with the activation of stereotype threat and its related negative outcomes (Aronson et al. 1998). Second, we must normalize critical reflection and inquiry in the core practices of our organizations—in our specific case, education and research—explicitly engaging multiple perspectives. Enacting cultural and institutional change also involves reforming the ways in which we teach and contextualize computer science and how we do research. Inspired by the Copenhagen Tradition of computer science, characterized "by maintaining a close connection with applications and other fields of knowledge" (Sveinsdottir and Frøkjær 1988, p. 468) and which follows an approach in which "dogmatic ideas are constantly challenged and people are being supported in revising their views in light of new insight or due to changed circumstances" (ibid) we propose to emphasize, in our core practices, critical reflection to better understand how computer-mediated systems impact society. Shifting towards critical awareness on how socio-cultural constructions such as race and gender are performed and how they intersect with other systems of power is crucial to enable technologists and researchers to better understand how inequity manifest in socio-technical systems, as highlighted by a growing body of research in CSCW (Ogbonnaya-Ogburu et al. 2020; Spiel et al. 2020; Burtscher and Spiel 2020). Third, we need to diversify and improve data collection to create opportunities for internal dialogue – cross-functionally—in order to grow. Tech institutions need to open up and be welcoming to people with different backgrounds and interests, which concretely means they need to identify areas for improvement and continuously assess progress. This requires moving beyond collecting recruitment and retention data and tailoring both the data collection, and the methods used to gather data, towards concrete goals. At the same time, it is crucial to find ways to create internal dialogue, taking into consideration the concrete multiplicity of social arrangements comprising the institution (Table 1).

Table 1. Three basic principles for an equity-focused approach to institutional accountability.

Equity-Focused Institutional Accountability – Basic Principles
1. **Examine organizational traditions, rituals, and spaces**: Situate equity efforts in their local contexts: examine organizational traditions, rituals, and social spaces to critically evaluate, address and counter marginalizing narratives and behaviours
2. **Normalize critical reflection in core practices**: Normalize critical reflection and inquiry in the core practices of the institution explicitly engaging multiple perspectives
3. **Diversify and improve data collection**: Improve and expand methods for data collection ensuring diverse types of data about equity to create opportunities for institutional dialogue in order to grow

Bold emphasis is to improve legibility and emphasis on the main principles we propose

6 Conclusion

This paper was an intervention. We interrogated the practices of our own organization, the computer science department of a large Danish university, to tease out some of the current hurdles in creating a more equitable and welcoming environment. While efforts to promote equality in organizational settings often focus on *diversity*—the numerical representation of specific groups of people (for example women or people from specific ethnic backgrounds), or *inclusion*, stressing how people can better feel included in a given structure, here we emphasize *equity*, which is created when unnecessary and unfair differences or unfair conditions (often gendered, or racialized for instance) are identified, addressed and eliminated. A focus on equity means zooming in on the unintentional or intentional barriers (often rooted in pervasive bias, or structural dynamics) that prevent certain groups of people from reaching their full potential. We zoomed in the stereotyped narratives embedded in the organizational traditions, social practices and sociomaterial artefacts of our institution. In particular, we looked at how these narratives might be expressed through humor, creating elusive challenges which counter current efforts to make our institution a place where all talents can thrive. From the analysis of our empirical material, we identified a set of cultural stereotypes couched in humor which we grouped in three main themes: gendered stereotypes of computer geeks; stereotyped representation of women; stereotypes on techno-capitalism and race in global software development. Our goal in sharing this analysis was to show how any efforts to broaden participation in computing has to go beyond the headcount and should go hand in hand with a critical examination of situated socio-cultural norms and values in order to make change.

The second aim of this study was to explore which challenges negative cultural stereotypes raise for the institutional response and accountability where they are produced. In a collegial, participatory culture such as the one of the computer science department we studied, institutional accountability is complex. Mapping out issues to generate a good overview of gaps in prevention and handling strategies is an essential step to do strategic work. But how do we integrate this critical perspective in the practices of our institutions, so that the focus is not only on increasing numbers of specific minorities, but rather on ensuring an open, welcoming environment which is psychologically safe? As a way forward, we proposed an equity-focused approach to institutional accountability with three basic principles that organizations can follow to identify and address: 1) Examine organizational traditions, rituals and spaces; 2) Normalize critical reflection in the core practices of the organization; 3) Diversify and improve data collection.

Further research is needed to unpack how biased humor encoded in artefacts, spaces, and organizational practices of technology organizations impacts intersectional identities both inside and outside academia.

Declarations

Conflict of Interest The authors declared that they have no conflict of interest.

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DOREEN: A Game of Provocations Creating New Ambitions for Equity in Computing through Intertextual Design

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Figure 1: DOREEN octahedron die with provocations

ABSTRACT

We introduce DOREEN, a norm-critical story-telling game of provocations that displays women's invisible experiences in computing to challenge barriers to inclusion. Following the principles of intertextual design, we collected empirical narratives from the past experiences of everyday women in computing and embedded these within the mechanics of role-playing storytelling games. With DOREEN we propose a playful way of exploring how gender roles, assumptions about computing, and social dynamics shape the experience of students – to reflect on the past with the aim of changing the future. DOREEN makes intertextual referencing to *The Unbeatable SQUIRREL Girl* aka Doreen Green, a computer science college student and a Marvel superhero who finds unorthodox ways (using wit and humor) to overcome barriers. DOREEN is a game to enjoy while engaging in critical reflection on belonging and well-being within computing. DOREEN is centered around an octahedron die and an adventure sheet inspired by tabletop role-playing gaming, emphasizing story-telling as a strategy for challenging norms and creating alternative narratives. The die design invites the players to reflect on how the probability of encountering limiting narratives and structural barriers can be higher or lower for different social groups. Finally, DOREEN is designed as the embodiment of all the people whose experiences, agency, and perspectives should be included in the journey of broadening participation in computing.

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NordiCHI '22, October 08–12, 2022, Aarhus, Denmark

ACM ISBN 978-1-4503-9699-8/22/10…$15.00
https://doi.org/10.1145/3546155.3547289

CCS CONCEPTS

• **CCS CONCEPTS**; • **Human-Centered Computing, Social and Professional Topics**;

KEYWORDS

computer science, gender stereotypes, research-through-design, role-playing, critical design artefact, norm-critical play, feminism

ACM Reference Format:

Jenny-Margrethe Vej, Valeria Borsotti, Valkyrie Arline Savage, Morten Engell-Nørregård, and Pernille Bjørn. 2022. DOREEN: A Game of Provocations Creating New Ambitions for Equity in Computing through Intertextual Design. In *Nordic Human-Computer Interaction Conference (NordiCHI '22), October 08–12, 2022, Aarhus, Denmark*. ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3546155.3547289

1 INTRODUCTION

With this critique and accompanying critical artefact: the game DOREEN we want to acknowledge and display the everyday invisible experiences of women within computer science. In the years between 2010 and 2015, only 81 students out of 874 students at our Department of Computer Science were women – and the first author of this critique was one of them. As a student, the first author left the master's program in early 2016 for a successful job in the IT industry - and she was not the only one who ended up leaving. Since 2015, the department has initiated and implemented several different strategies, structures, and activities to increase gender diversity - and has been successful in this effort: approximately 20% of new incoming bachelor students since 2016 are women, while the number was around 8% prior to 2016 [9] [22]. However, opening up institutions to those who have been historically excluded from them is not just about improving representation; it is also crucially about reflecting on how we can establish and maintain inclusive culture and needed structural change [12].

To fully comprehend current social dynamics and how they support or hinder conditions for equity, we need to reflect upon past experiences, with the aim of creating discussions and conversations in the present to impact future narratives about computing and to promote inclusivity [2] [25]. To gain insights into the past, the first author interviewed 10 women students. The students interviewed are former and current Computer Science students who started their education at our department in the years between 2010 and 2015 (prior to the introduction of the new diversity initiatives). These ten women make up more than 12 % of the women who started in the Computer Science Bachelor Program during this time frame. All interviews have been recorded and fully transcribed. From the analysis of the empirical material three sets of narratives about computing and gender emerged, which together provide insights into the ordinary, personal experiences of the very few women in a computer science program. Whereas all the students in our interview sample identify as cisgender women, many of the cultural and structural barriers described in this essay also affect the lives of other gender minorities and historically underrepresented groups in computing. We would like to stress that bringing attention and critical reflection upon students' experiences requires institutions to be proactive, accountable, and willing to become vulnerable in the process of learning to make a change. We are currently based at such an institution, and we hope other computer science organizations with similar backgrounds will join us so that together we can acknowledge, transform and redefine current norms and create more inclusive environments.

DOREEN is a critical design artefact [21] created to spark change in computing by creating new sustainable futures through reflection, dialogue, and interventions. We are using DOREEN to initiate and facilitate conversation on social norms, narratives, and social dynamics in computing environments. Notions about gender/sex shape computer science in particular ways. Stereotypes and gender norms influence access and participation in computing activities as well as impact people's sense of belonging – whether they are in education, research, or industry settings. Biased social norms and social dynamics, if left unchecked, also affect how technology is shaped. Feminist Science and Technologist scholars have long emphasized how biased understandings and articulation of "users", for instance, influence research and technology development, and reduce and constrain the access and use of technology [23] [24]. With DOREEN we propose a playful way of exploring how gender roles, assumptions about computing, and social dynamics shape the experience of students – to reflect on the past with the aim of changing the future.

Our game, DOREEN, is centered around a thought-provoking story-telling game die. The die is an octahedron, on each side of which players can read empirical quotes from our qualitative interviews or critical questions based on our own experience as researchers facing complex dynamics in the classroom. This way, we display both the invisible experiences of the women, and invite reflection on the complexity of what can be done to challenge harmful stereotypes. Besides capturing the marginalized narratives that organize value judgements in computing around gender/sex – like male/female binaries, we also display the marginalizing narratives in computing research subdomains concerning what is considered soft or hard in computing, as well as the different perceptions between technical contra human-centered approaches. With DOREEN we engage people in reflection on how marginalizing narratives are deeply ingrained within computing, and their consequences.

Applying intertextual design [10] we blend references to pop culture - like tabletop role-playing games (RPGs) and the Marvel superhero Squirrel Girl - with quotes and prompts about experiences within computing to engage people in playful critical reflection, with the intention to broaden the conversation on equity in computing. The fundamental questions we seek to discuss based on the provocations displayed in the game are: *What dynamics are caused by preconceived assumptions about gender and computing? How do these impact the experience of women (and other gender minorities) in computing? How can we challenge assumptions in our work as researchers, teachers, managers, administrators, or students?* We invite NORDICHI participants to play DOREEN at the conference and discuss, share, and engage with everyday stories displaying the experiences of underrepresented groups within computing, with the purpose of collaboratively creating new ambitions for where we want computing to be in the future.

DOREEN uses the same mechanics underlying the configuration of byte patterns: This way we emphasize that the experiences of students are multiple, diverse, and – not least - re-configurable. We reference 8-bits computing, inviting participants to configure and

reconfigure 256 (0-255) byte patterns of the students' lived experiences. By repurposing the polyhedron dice shape from role-playing games, we create a playful environment allowing participants to reflect on current challenges to collaboratively envision a better future.

The rest of this essay is divided into two main parts: In the first part we explore Collected Narratives and the in the second we explain The Design of DOREEN. The Collected Narratives section briefly documents our empirical data and highlights three main empirical narratives. The Design of DOREEN section introduces the game, tokens, and rules, as well as the material design, form, and interactivity designed to allow players to reconfigure the future ambition of computing by reflecting on the past.

2 COLLECTED NARRATIVES

Our data collection centers the voices and experiences of women in computing higher education. In approaching this theme, we are inspired by the work of feminist scholar Sara Ahmed, who has long examined issues of sexism and racism in universities. Ahmed invites us to reflect on how neoliberal agendas tend to make feminism about the resilience of individuals, rather than focusing on the importance of collectively examining (and challenging) how sexism is produced and reproduced [1]. Sexism, Ahmed notes, is often reproduced by not being noticed (ibid). In this essay and in our game DOREEN we explore the experience of 10 women students of computer science, explicitly centering limiting narratives that have been rendered invisible and normalized and invite people to discuss them, explore them, challenge them, and propose ways to counter them.

Feminist HCI researchers have in the last decade increasingly critically brought in and centered the experience of marginalized identities in computing [3] [6] [10] [16] [17] [22] [25] [26] and developed approaches to promote inclusivity, accountability and reflexivity in HCI education and in computing [13] [14] [8]. Aligned with this work, we focus on the experiences of women in computing as they articulate their own experiences with mechanisms of marginalization and exclusion, in order to bring awareness about how values and assumptions related to gender and technology shape computing environments. Madeline E. Heilman defined stereotypes as generalizations about groups in which have two properties: a descriptive and a prescriptive [19]. Descriptive gender stereotypes are binary constructs depicting what women and men are *like* whereas prescriptive gender stereotypes are directed at how women and men *ought to be* (ibid, p. 114). She continues by stating that the "descriptive stereotypes promote negative expectations about a women's performance by creating a perceived 'lack of fit' between the attributes women are thought to possess and the attributes thought necessary for success in traditionally male positions" (ibid, pp. 114-115). It is important for us not to frame the experience of women and other marginalized genders in computing in terms of deficit (a lack of resilience, a lack of skill). Women are not 'missing something' or 'lacking something' which makes them 'less inclined' to be technically successful in computing [7]. Women and other underrepresented minorities have agency and the perceived 'lack of fit' is shaped by social norms and institutional conditions – their agency is constrained or supported by socio-cultural factors. Thus, to make change, the computing community needs to carefully examine, acknowledge, and challenge barriers to participation and inclusion. Following others [5], our agenda is not to change women, but to change institutions allowing women and other underrepresented gender minorities to pursue their own agendas and impact the computing agenda of the future.

To spark critical reflection, we wanted the narratives and stories on the DOREEN octahedron game die to be grounded in the real-life experiences of the women interviewed for this work. When analyzing the data material, we traced both descriptive and prescriptive gender stereotypes which clearly impacted the experiences of the women. For the purpose of critical reflection, we present three sets of narratives that merged in the interviews and that we used in the design of DOREEN. These three sets of themes were: 1) Normative stereotypes about gender and technology; 2) How attitudes toward human-centered disciplines shape the nature of socially oriented work within Computer Science; and 3) How the transformative role of creative expression and spaces for social belonging were essential ingredients for wellbeing. For each of these themes, we identified and selected key quotations from the women's experiences.

2.1 Normative stereotypes about gender and technology

All interviewees pointed to the existence of a descriptive stereotypical belief that men are naturally more technically well-versed and that women's technical abilities are inferior. This stereotyped narrative was embedded in jokes or occasional comments and social interactions on and outside campus, which negatively affected the students and their sense of belonging. Sexist remarks like the one quoted below are a good example of the descriptive stereotyped narrative linking gender and supposedly innate technical skills:

> "I heard comments outside of my university, like "You code well for a woman."

Some students discussed the uncomfortable feeling of being in the spotlight, which added another layer of pressure. As one woman said:

> "It was a little intimidating to start, because I was very aware that I was one of the few women, and you get a lot of attention, and everyone quickly knows your name even if you don't know them"

Being aware of the negative stereotype negatively impacted many aspects of the students' learning experience. Many of the women for instance reported not feeling comfortable openly asking for help. As representatives of a small minority on campus, they felt it was hard to ask questions in class. Self-confidence was affected too. Some women reported that, if they got a bad grade, they would start questioning whether it was because of their gender - rather than objectively evaluating their personal situation:

> "If you were bad at something, was it because you were a woman or was it a difficult course?"

> "Failing a course was really tough. You felt that you were that girl who didn't know how to do anything. It was only in a few courses where 70% of the students failed and where everyone knew that it was a deeply

> unfair exam and not your lack of skills, where it was okay [to fail]"

The women felt extra pressure not only to prove themselves as good students – countering the descriptive stereotype - but also to positively represent their gender, as the quote below shows:

> "I didn't want to live up to the stereotype. You feel like you represent your whole gender. If you failed at something, your entire gender failed."

The experiences we document demonstrate how normative gender expectations risk producing *stereotype threat* [4] [27]. Stereotype threat is a concept that describes "being at risk of confirming, as self-characteristic, a negative stereotype about one's group" [22: p.797]. Stereotype threat has been shown to affect the wellbeing, performance, and participation of gender minorities in computing, and thus risk countering initiatives for diversity and inclusivity within institutions [15]. Research on stereotype threat and race have documented how simply experiencing or becoming aware of the stereotype can impact performance. Thus, to make change within computing, we need to acknowledge and critically reflect upon descriptive gender stereotypes to find ways to counter them within organizations.

2.2 Attitudes toward human-centered disciplines within Computer Science

Attitudes and norms about gender might overlap with preconceived notions about specific computing subdomains and might be reproduced through institutional practices. One of the stories we collected was related to the experience of selecting a computer science program. The event took place during an Open House event, as the woman explains:

> "I went to an open house at [edited] with a female friend when we were picking our university. And we were met with some sexism, so we did just turn 180 degrees and left. They had a booth where you could hear more about the Software Development program. As soon as they spotted two girls approaching, they hid the Java book and said, "Listen, it's about people". Great, but you could please not assume? I want to code and learn theory."

The students were stereotypically perceived as mostly interested in "people" rather than programming, which countered their actual interests. This experience points to the stereotypical assumption that masculinity is linked to hardness and technical domains, where femininity is linked to softness and people - even if there is no evidence that technical domains should be gendered. The existence of specific attitudes towards sub-areas of science matters for the perceptions of domains where some topics are "considered hard, and in the discourse, these are furthermore related to masculinity and given more merit, whereas others are regarded as soft, feminine and given less merit" [28]: p.519. The distinction between what is 'hard' and what is 'soft' within computing also emerged as a topic in our interviews. Perceptions about what is "real" Computer Science were largely linked with how much programming the course entailed. For example, a woman said:

> "There was this idea that Computer Science only counted the programming heavy things whereas becoming a teacher, going into management or user interaction wasn't real Computer Science."

These assumptions also shaped, to some extent, the educational path of students. At the time the women interviewed attended their education, Human-Computer Interaction was not a mandatory part of the core curriculum, and some students regretted not choosing that optional course, and explain what informed their choice:

> "In general, some courses were seen as less worthy than others. Meaning the programming-heavy courses were definitely the best ones. And that meant I never took Human-Computer Interaction because people said it was silly. But today I would have liked to have that theory with me."

Another woman mentions that, in her view, this pressure and bias towards what was considered as "real" Computer Science compared to "not real" was embedded within the ways students talked and articulated the program, pointing to the important role of former students in shaping the assumptions about the topics.

> "You get pressured a lot towards the tech-heavy courses rather than the more interdisciplinary ones, and I think this is a shame. I am also pretty sure it is coming from the students."

Two other women further elaborate:

> "It became almost elitist in some ways. The more programming work you do, the better it is, hence the more you are worth as a human, almost".

> "The more technical courses were put on a pedestal. I really enjoyed Human-Computer Interaction. But I had to listen to comments about how it did not have anything to do with IT. It was just easy ECTS. It was soft. Same with Project Management. If you were not programming, it didn't matter"

Prioritizing sub-areas within a field above others matters for the experience of a field. Computing is a newer academic field compared to e.g., Physics and Math, as the field and practice only emerged during WW2, and the first Computer Science department in Denmark was not established until 1970. Digital technology develops at a rapid pace, and no one can predict where the field will be in just 5 years into the future. Human-centered topics and areas are important if we are to develop technology for people, which means that the limited understanding of the 'real field of computing' is counterproductive for the kind of skilled experts which are needed in society. Educational institutions and programs are shaped by the assumptions and tacit expectations co-produced by teachers and students. Whom the "implied student" is [28] matters for the experienced behavior and activities which participants encounter in formal and informal educational spaces within the program, and which are crucial factors shaping the wellbeing and attainment of students.

2.3 The transformative role of creative expression and spaces for social belonging

Throughout the interviews, it became clear that joining social groups and extracurricular activities organized by the students were important ways to foster a sense of belonging and build community - and in some cases, these became spaces in which students challenged normative stereotypes. The revue (the university's own musical theatre) stood out as one of the social activities that played a positive role in the students' life, as 9 out of 10 women reported. The revue at our Computer Science Department was created in the early 70s and is a yearly event where students perform the sketches, songs and videos they have been laboring on during the previous year. It is a group open to everyone who has a relation to Computer Science, including teachers - who also often join on stage and in videos. The students create their own band every year, a tech-squad handling sound and light effects together with the videos. They create their own costumes and props, and they also work together with other student-run revues throughout the year. As the below quotes show, students who were actively participating in the revue saw it as a place in which they could be themselves, express their creativity, make friends, and not be judged:

> "The revue was a place to be yourself. People didn't care if you drank, or you could code. You could just have a great experience with other people. It probably wasn't ideal that you had to take a week off from studying to do the revue itself, but it was really amazing."

> "I was in the revue, I was a mentor, I was in other social groups. The social part made a difference for how long you would last."

> "In my first year I was really focused on my studies, but I later joined more social groups. I really tried focusing on being social (. . .) The social aspect was really important and it definitely carried me through. I hope it's still like that. It's the only way to get through it. You need someone to talk to - people who relate to your studies and assure you that you are not alone."

The revue was experienced as an open space for the women we interviewed, where students could be part of a group without having to worry about their gender, dislike for alcohol, or coding proficiency. One of the factors that could support this welcoming feeling was that the revue seemed very diverse. One woman mentions that it was probably one of the social groups at the department where most women were present and participating. Further, the revue was experienced as a place, event, and activity where people could unfold their characteristics without limitations and make new friends.

The material for the revue is usually a reflection about the students' everyday life with a twist of humor and a sense of irony. One of the songs from 2014, called 'Let It Grow', stands out in its ability to challenge normative stereotypes with humor. Based on a song from Disney's animated movie Frozen, called 'Let It Go', the satirical song ridicules the stereotype of the Computer Scientist as a bearded man and pushes back with humor against the idea that women are not naturally technically inclined. The song was performed as a duet between two women Computer Science students – one who really wants to grow a beard in order to fit in and be a true Computer Scientist, and another one sharing how she can accomplish that by simply buying a beard from the local costume store. The song-writing process and the performances show how creative expression through the musical theatre provides a public space to talk about and counter these stereotypes in a clever way.

Is important to us that we included the lived experiences of the women as a feature of our norm-critical artefact. The goal is to critically examine the experience of marginalized students to understand which structures, activities, and practices we need to change and/or strategically prioritize. Increasing diversity is not about changing people to fit into existing structures but changing the structures to allow people to express themselves within the field. We offer the DOREEN game to help people critically reflect and develop future scenarios changing the narratives and practices of computing towards equity and inclusion.

3 THE DOREEN GAME

DOREEN is a norm-critical conversation game that allows participants to become aware of and discuss norms about gender and computing. The game helps players imagine how they can intervene to create a better future. The design of the game blends provocations, playfulness, and story-telling mechanics from tabletop role-playing-games (RPGs) such as polyhedron dice and adventure sheets. The *provocations* are snippets of the empirical quotes displaying the experiences of the 10 women we interviewed, combined with critical questions based on our own experiences as teachers. In total we include 16 empirical snippets, mimicking the 8-bits structure of computing memory in a bite allowing for in total 255 different combinations of story-telling elements across the provocations. Each provocation can be a singular entity for discussion and reflection as well as an element in a larger collective story that can combine several provocations.

3.1 Story-telling and role-playing to create new narratives

The *story-telling mechanics* is inspired by the dice used in RPGs, such as Dungeons & Dragons (D&D). Since our intention is to get participants to critically reflect upon past narratives to create new ones, the story-telling element of RPGs is an excellent metaphor for how we want participants to engage with each other and create new stories of the future. Polyhedral dice sets are a core element in most RPGs, where the die throw brings in probability and fate to the story-telling activity [11]. The DOREEN game is centered on an octahedron die. Dice have been a historical part of ceremonial behavior and rituals in many cultures and societies worldwide (Ibid). Dice rolling in D&D is used to generate scores for various dimensions of a character. Role-playing games typically make use of a combination of differently shaped dice: The Dungeons & Dragons dice set includes a set of d4 dice (with four sides), d6 (six sides), d8 (8 sides), d12 (12 sides), and d20 (20 sides). Rolling dice determines the *ability score* of characters or the numeric representation of their physical and mental attributes. Biased assumptions of gender

have been embedded in D&D over the years. Scholar Antero Garcia notes:

> "One of the places where the choice of a character's sex does make a difference is in physical ability (. . .) females have lower strength than males. In a system where you can be an elf, cast powerful spells and barter with dragons, the notion that women could be as strong—if not stronger—than men was too preposterous to be developed within the system." [18] p.238

The design of DOREEN die is a classic octahedron dice used in RPGs, the so-called "d8" or 8-sided dice. Dice, and the statistical probability connected with their use within the rules of the game system, play an important part in the way the adventure unfolds – and in some cases the gender of a character might specifically affect dice rolls and the statistics connected with them. In early versions of D&D, for instance, a female character's strength was determined with a roll of one d8 and one d6 (i.e., with a range from 2-14) – instead of three d6 (i.e., with a range of 2-18) as was used for male characters, restricting the range of the possible outcome [20]. The system of possibilities in the early days of D&D was back then more open for strange magical creatures than imaginary female characters. However, things have evolved and changed, with more recent editions of the game being edited and refined with stronger attention toward equity and inclusivity - the role of gender and other social identities is now featured in the D&D Player's Handbook, stating:

> "Characters are defined by much more than their race and class. They're individuals with their own stories, interests, connections, and capabilities beyond those that class and race define. (. . .) You can play a male or female character without gaining any special benefits or hindrances. Think about how your character does or does not conform to the broader culture's expectations of sex, gender, and sexual behavior" [27, p.121].

The RPGs landscape has recently seen an influx of independent, women-authored role-playing games like Savage Sisters [29] that push the boundaries even further, by centering the actions of warriors women as the main characters of the game – and that articulate queer and feminist approaches to collaborative storytelling in the handbook – not least by humorously defying well-established norms like changing the classic acronym for the storyteller, the GM or "game master", into the "GrandMother". DOREEN brings the same feminist approach to collaborative storytelling within institutional settings.

3.2 Multiplicity, possibility and intertextuality

The intertextual design of DOREEN reflects two numerical systems that are foundational to computing: The binary (0/1) and the 8 bits that form the basic unit of digital information: The byte. We designed an octahedron die not only to reference the classic d8 in D&D, but also to reference the 8-bit architecture in computing. Each side of the triangle that composes the dice, side 0 and side 1 – refers to the binary standard in computing. All signals in a computer have two values: 0 (which can be thought of as *off*, or *false*) and 1 (*on* or *true*). So, a byte - the unit composed of 8 bits - represents 2 to the power of 8 different values: 256 values (0-255). Variations of early 8-bit processors are still common in embedded systems today, and the first commercial 8-bit processor, created in 1972, was the Intel 8008.

The *playfulness* of DOREEN linking to RPGs is in line with the idea that characters (people in computing) are much more than their race, gender, and class. With this playfulness, we want to reflect the experience of some of the students who created new and alternative narratives about computer science, and gender. The theatre plays became a place for the interviewees to be themselves, express their perspectives and experiment with different roles, defying dated assumptions and stereotypes – so we wanted the game-play of DOREEN to be a playful, exciting, and fun experience. Here the intertextual referencing to the Marvel *Unbeatable Squirrel Girl* also introduces not only a *girl-squirrel* computer science student character (aka Doreen Green, the computer science college student), but also her wit and humor which together with her power (e.g., superhuman strengths and agility) and abilities (e.g., heightened reflexes also called 'squirrelgility', and ability to communicate with squirrels) create unorthodox solutions to overcome barriers. We see the stories related to the revue in our empirical material as an expression of how through wit and humor women critically talked about their experiences of being in computing and created alternative narratives. The revue performances thus become a new form of language - a new superpower - which can communicate lived experiences allowing others to understand them from the perspective of those at the margins. Similarly, the DOREEN game is about providing a vocabulary while producing an experience where participants are empowered to collectively create new stories about future ambitions in computing, including strengths (superpowers) to find unorthodox ways (using wit and humor) to highlight and challenge barriers. We chose to weave in the intertextual reference to Squirrel Girl/Doreen Green also because with it we want to highlight the recent change in the traditionally male-dominated superhero industry. Mainstream superhero comics, just like RPGs, have historically had issues with stereotypical and unequal depictions of gender and race, but recent years have seen an increase in awareness of these problems. Some large companies like Marvel (now Disney-owned), have started working on improving the way they represent and depict gender, ethnicity and sexuality in their comics and movies, following the general trends of raised awareness of the importance of fictional characters as role models. Other examples besides Squirrel Girl could be the comparatively new Ms Marvel series, featuring a young Muslim girl in the lead role, or Captain Marvel.

DOREEN displays and reflects the limiting narratives and roles emerging from our data as well as the *creation of new Adventures* inspired by the new characters and roles created in the theatrical play in the Computer Science Revy. Additionally, DOREEN brings in reflections on the societal pressures of "*role modeling*" when embodying a marginalized gender identity in computing, which was described as a burden by some of the women interviewed – restricting them from the possibility of "just being oneself". DOREEN translates the tension between the constraining and empowering dynamics afforded by roles (gender roles, "role modeling", fictional creative roles etc.,) – while drawing references to subcultures close

to computing which are changing to become more inclusive (D&D and the Marvel superhero industry).

3.3 DOREEN game, rules, tokens, and players

The purpose of DOREEN is to create ambitions for the future of computing, including ideals, strengths, and barriers. The game will be exhibited the first time during the NordiCHI 2022 conference in Arhus, Denmark, and conference attendants will be invited to play together. The players start by selecting and assembling the octahedron die, selecting from the possible triangles with provocations. When the die is assembled, participants receive an *Adventure sheet*, which they will fill out together as a small group during the game. The purpose of the game is to collect three different experiences (provocations), by rolling the die and use these as the foundation to propose one ambition for the future of computing. For each provocation, the participants discuss the experience and brainstorm possible ideals without limitations for the future of computing including barriers and strengths. When all the three provocations are collected, the participants evaluate and examine their ambition with related ideal, strengths, and barriers - and use this material to formulate a statement for the future.

The DOREEN game includes 16 provocation triangles, 1 DOREEN octahedron die structure, and 1 DOREEN Adventure sheet. The provocation triangles are 16 equilaterals (16 cm) acrylic laser-cut triangles, each inscribed with selected and cropped quotes from our empirical material. The provocation triangles can be assembled and reconfigured in any way or form on a 3D-printed structure with the use of small magnets. The DOREEN Adventure Sheet is based upon the D&D characters sheets. On it, players document their engagement, and formulate their statements for the future of computing.

The DOREEN game rules are as follows:

1: Roll die; discuss provocation; formulate Ideal

2: Roll die; discuss provocation; formulate Barriers

3: Roll die; discuss provocation; formulate Strengths

4: Based upon the above, finish the statement collaboratively: Our Ambitions for *the Future of Computing. . ..*

We want people to create their own customized DOREEN games, thus we share all the digital fabrication schemes and templates freely available online on the www.femtech.dk website, including our provocations. However, we invite others to customize the DOREEN game by adjusting it to document and display their own experiences, as well as sharing the resulting Adventure sheet online - so that we can acknowledge problematic narratives and find ways to create new futures together. If we are to achieve equity, increase diversity, and further inclusion in computing - it is a collective task to create spaces and environment which foster equity for all.

ACKNOWLEDGMENTS

We would like to thank Jonas Schjerlund for the discussions and help with the pictures.

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Neurodiversity and the accessible university: exploring organizational barriers, access labor and opportunities for change.

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The access needs of neurodivergent individuals in organizational settings are many and varied – and so are their everyday contributions to the creation of collective access. In this study, we contribute to the growing body of CSCW research on accessibility and investigate the invisible access labor of neurodivergent students in three computer science institutions. We use an exploratory, multi-stakeholder approach, combining semi-structured interviews (n=26) and document analysis. We adopted a broad definition of neurodiversity: our study included individuals with autism, dyslexia, ADHD, cyclothymia and individuals with neurological conditions that developed as a result of illness, trauma or injury. Our findings show that neurodivergent students face a number of structural and attitudinal barriers to access in the educational environment and within the disability support system. We identified barriers in three main areas: (i) assistive technology access barriers, (ii) cognitive and physical access barriers, and (iii) social access barriers. We examined how stigma, individualized understandings of disability and intersectional disadvantage shape organizational practices and explored how students are creatively improving collective access through micro-interventions, although these efforts are largely invisible. We then draw on our findings to identify opportunities for change. We propose access grafting as a bottom-up approach to rethinking and reorienting organizational strategies to improve equitable access.

CCS Concepts: • **Human-centered computing → Empirical studies in accessibility**; *Accessibility*.

KEYWORDS: Neurodiversity; accessibility; intersectionality; access labor; equity; norm-critical.

ACM Reference format:

Author and other authors. 2023. Neurodiversity and the accessible university: exploring organizational barriers, access labor and opportunities for change. In *Proceedings of the ACM on Human-Computer Interaction,* Vol. 5, CSCW1, Article # (April 2021), XX pages, https://doi.org/10.1145/33XXXXX

1 INTRODUCTION

Accessibility work is cooperative and shaped by situated organizational practices, policies, implicit social values and norms. HCI research on accessibility has been increasingly focused on the sociocultural dimensions that enable or restrain equal access to resources, services and activities [11,41,70]. This strand of research maintains that disability is relational, and it is always produced through interactions between individuals and complex sociomaterial contexts. These studies uncover new possibilities for design by building on work by disability scholars and critical access scholars [35,43], framing accessibility as collaboration across multiple actors, and stressing how special accommodations should always be studied in concert with socio-technical considerations [7]. As these studies document, the work of creating equal access in organizations has historically been made possible by the often-

invisible labor and advocacy of many people with disabilities[1]. CSCW as a discipline has been instrumental in unraveling the politics and implications of invisible work [60,61,76,77]. However, accessibility and the invisible work behind it have received only limited attention in CSCW literature so far [55,63,87,88].
This paper focuses on neurodiversity, a topic that is relatively less explored in relation to accessibility. A recent review of HCI research shows that many accessibility studies to date have focused on the experience of blind and low-vision people, followed by people with motor impairment and deaf and hard-of-hearing communities [48]. Neurodiversity, cognition-related disabilities, psychological conditions, and/or multiple disabilities are less well-represented (ibid), thus additional work is needed because these conditions are prominent in our society. The intersection of accessibility and neurodiversity has been researched in CSCW and HCI in relation to barriers in the workplace [22,59,88,92]; children and youth [19,27,29,33,74,75], and higher education in general [1,14,28,82].

Here, we focus specifically on access labor – the practices of negotiating and seeking equitable access to organizational services, technologies, and resources – as it is experienced by neurodivergent undergraduate students in Computer Science (CS), a relatively understudied topic which is of great importance: Computer science (CS) education still grapples with remarkable issues around lack of equity and inclusivity [10,17,18,52] – not least when it comes to centering accessibility both in organizational practices and in the curriculum [6]. Our study is motivated by a wish to support computer science institutions in becoming more open to bottom-up, norm-critical ways of organizing and rethinking accessibility – by highlighting both barriers and emerging opportunities for change.

The research questions (RQs) guiding our study are:
RQ1*: What are the main barriers to access experienced by neurodivergent students in CS?*
RQ2: *How can we re-orient cooperative organizational practices to better support equal access?*

Applying a multi-stakeholder approach, we conducted a qualitative study featuring both document analysis and in-depth interviews with 18 neurodivergent students, 3 teachers, 2 tutors/mentors, and 3 disability officers across 3 Danish computer science departments in 3 different universities. We adopt the interdependence framework [7], which emphasizes collaborative access and establishes neurodivergent people as both *contributors and recipients of access, support and community-building*. Through this analytical lens, we identified not only a range of structural and interpersonal barriers but also local bottom-up *micro-interventions* through which students and their allies generate and improve collective access for the neurodivergent community at large. We give significance to collective micro-interventions as a way to reorient work practices and inspire new strategies towards inclusivity for neurominorities, considering how bottom-up knowledge and workarounds can be integrated into the current infrastructures [44,45].

[1] We use both person and identity first disability language, reflecting that our participants used a mix of both.

The main contributions of this paper are empirical, conceptual and practical. First, we contribute new empirical evidence on the cooperative and invisible work of access labor [11,88] by documenting (i) the access barriers encountered by neurodivergent students and (ii) emerging micro-interventions for collective access. Second, we extend previous CSCW research by identifying access labor as complementary to articulation work in cooperative engagements, highlighting how organizational barriers require extra effort and time for neurodivergent students to participate and thrive in education. We propose **access grafting** as a collaborative approach to reorienting organizational practices: Drawing on critical access theory and disability studies [35,43] we suggest that through access grafting, new knowledge, ideas and practices centering accessibility and disability by neurodivergent people and their allies are joined into existing organizational structures. We argue that to be able to fully develop and grow, these new branches must be supported by a strong root system. This means, in practice, building organizational readiness and confronting structural ableism through ongoing leadership and staff training on disability, neurodiversity and accessibility, ensuring financial backing for initiatives, prioritizing effective cross-functional stakeholder collaboration, and introducing policy changes.

2 BACKGROUND

2.1 Understanding neurodiversity: cognitive, sensory and social differences

Neurodiversity is an umbrella concept coined by sociologist Judy Singer to destigmatize "atypical" neurobiological structures and celebrate human variation in how nervous systems interact with the world [71]. The experience of neurodivergent folks is shaped by multilayered needs - not only in relation to sensory, cognitive, and physical differences but also to their diverse and intersecting embodied social identities and emotional needs. We frame neurodiversity holistically, covering its physical/cognitive characteristics but also highlighting how intersectional factors like mental health, gender, immigrant status, sexual orientation, ethnicity - and more - shape how neurodivergent individuals interact with socio-technical systems, intensifying some of the access barriers. We also adopt an expansive definition of neurodiversity. While many studies on neurodiversity tend to be limited to autism, ADHD, dyslexia and dyspraxia, we include the overlooked perspective of people with *acquired neurodivergence* – neurological conditions that develop as part of illness, trauma or injury, such as fibromyalgia, post-concussion syndrome or complex trauma.

While no two neurodivergent people are alike, there are areas in which their skills and needs tend to differ from their neurotypical counterparts.

- There are significant differences in *'executive functioning'*, a term that includes working memory, skills related to planning, initiating, and following through actions, inhibition, self-motivation, and focus [62,72].
- *Fluctuations in energy levels* related to fatigue and physical symptoms – and often compounded by external stressors, is another area in which the needs of neurodivergent individuals differ significantly, as they might experience periods (hours, days, or weeks) in which they grapple with physical, emotional, or mental fatigue [16,36,66]. A person with fibromyalgia, a neurological condition, might experience constant or frequent pain accompanied by fatigue [83].

- *Sensory sensitivity differences* manifest in different degrees of hypersensitivity or hyposensitivity - people with autism, ADHD, chronic illness, and brain injury, for example, might experience this around touch, smell, taste, sound, sight, proprioception (body awareness), or balance [20,38,89].
- The ability of *processing information* can also vary. People with dyslexia often use assistive technology in order to read or write text (or both) [51,54].
- Needs around *communication and social interaction* also present differences [26,58].
- Periodically grappling with *mental health* conditions was a common denominator for all the students interviewed. Neurodivergent individuals are more likely to have concurrent anxiety and depression, which in turn further affect their cognitive skills and energy levels [58].

We apply an intersectional approach to neurodiversity [50] as neurodivergent identities always intersect with and are shaped by other social dimensions such as gender and sexual orientation [90] [40], ethnicity [4,69] and socio-economic status [46] - among others - which translate into different diagnostic patterns, differential access to mental health care, differences in existing networks of care and support, and increased likelihood for some social groups to incur in mental health conditions.

2.2 The structural and legislative context: the accessibility landscape in Denmark

Our empirical material has been collected in three universities in Denmark. All higher education in Denmark is free and provided as a public service, and the extensive public system of disability support – in Danish SPS (Special Pedagogical Support) - is free and accessible upon proof of disability, integrated yet separated within higher education institutions. In this section, we briefly contextualize the accessibility landscape in Denmark.

Denmark ratified the UN Convention on the Rights of Persons with Disabilities in 2009. The convention maps and details essential actions to be pursued in relation to, among others, disability awareness-raising, anti-discrimination, and accessibility – which is broadly defined as "access on an equal basis with others to the physical environment, to transportation, to information and communications, including information and communications technology and systems, and to other facilities and services open or provided to the public" [93]. But according to a recent report from the Disabled People's Organizations Denmark (DPOP), there is still no national comprehensive plan to make these commitments more concrete [23]. The lack of extensive strategic regulations results in several accessibility gaps in many sectors, as well as cases of discrimination. Contrary to recommendations from the UN Committee on the Rights of Persons with Disabilities, Denmark also still has no strategy for the collection, analysis and dissemination of data on disability (ibid).

In Danish higher education institutions access is typically framed in form of accommodations - which also include assistive technology. But this is not enough to ensure that the needs of students are met. According to a 2021 nationwide survey, students with disabilities are less likely to start and finish educational programs [85]. They experience challenges with missing support, lack of flexibility, heavy and repeated bureaucratic tasks in the process of applying for accommodations, extensions and assistive tech [78]. The share of higher ed students registered with disability support services has increased from 3% in

2010 to 11% in 2020, but a recent governmental report raises concerns about inequitable outcomes: Students with disabilities experience lower well-being, more discrimination /harassment compared with their non-disabled counterparts, and they interact with study environments that are not designed to be accessible – resulting in multiple barriers [81].

3 RELATED WORK

We situate our research in CSCW/HCI, crip theory and critical access studies. Below we describe previous work about the socio-political and organizational dimensions of access; the intersectional and situated aspects of access in academia; emerging from research on neurodiversity and accessibility in higher education.

3.1 The socio-political aspects of access and interdependence

We align our work with the political/relational model of disability developed by queer and feminist crip theorist Alison Kafer [43]. Moving away from an "individual model" (or medical model) of disability defined as a personal problem affecting individual people, we understand disability as a *"potential site for collective reimagining"* (ibid p.9). Reimagining social and material contexts is essential, as access barriers are always rooted in existing socio-technical systems and can only be transformed with collective efforts. Applied to CSCW, the political/relational model of disability prompts us to interrogate the values and assumptions encoded in socio-technical systems, while centering the agency and knowledge of people with disabilities in envisioning new cooperative practices. Crip techno-scientist Aimi Hamraie stresses how the making and design of environments and artifacts always reflect complex politics of knowing, and introduced the hyphenated concept *knowing-making* to indicate the practices by which disabled people transfer *access-knowledge*, reshape and share spaces, create mutual aid networks, and experiment with technology – centering their expertise about their bodies and their environments [35]. Using access-knowledge as a theoretical lens, we also explore how students work for collective access based on their expertise and lived experience, rather than only focusing on individual workarounds to barriers.

Crip theory has informed new ways of understanding accessibility in HCI: the interdependence framework by Bennet et al. [7] emphasizes the collaborative aspect of accessibility rather than centering the technical - focusing on how *"myriad people and devices come together to build access"* (ibid p. 169) – and stressing the contribution of people with disabilities as co-creators of access. Interdependence foregrounds how barriers are rooted in contexts that are not actively supporting cooperation, communication, and professional development around access needs, and where disability is ranked lower [7]. Previous CSCW research drawing on interdependence has examined the collaborative work of accessibility in practice [84]. This study contributes to this growing and relatively small body of resarch.

3.2 Organizational and intersectional aspects of access in academia

To understand access barriers and access labor in the academic context, we draw on previous scholarship in this area. Disability theory and queer theory analyses on inclusivity in academic settings have illustrated that the mechanisms of exclusions are intersectional:

forms of social stratification and social oppression are always interwoven and intensify barriers [2,3,24]. Metaphors of flows are recurrent in conceptualizing how these mechanisms are produced and reproduced: Both Sara Ahmed and Jay Dolmage's work analyzes how the flow and circulation of discourse, and the ways knowledge around inclusivity and disability gets stuck in institutions, become central in how inaccessibility is reproduced – voluntarily or not - in the academy [2,24]. Ahmed refers to diversity practitioners in universities as *institutional plumbers*, whose main work is to get things unstuck. Dolmage conceptualizes universities as *rhetorical spaces* that enact exclusionary practices, particularly in regards to individuals with non-normative cognitive abilities: The expression "higher education" itself encourages and reinforces an ethos of valuing ability, perfection, and contributes to the stigmatization of intellectual or physical weakness, where cognitive disabilities are often ranked lower than physical - students are "faking it" or are seeking extra attention by demanding their needs to be met [24]. Tanya Titchkosky's work on the *bureaucratic making of disability* examines the role of social welfare systems in framing disability as individual function inability managed through bureaucratic practice [80]. By mapping out the unnoticed mechanisms through which universities reproduce disability as an individual problem, she invites us to consider how *lack of access becomes naturalized and made invisible* [79].

The availability of accommodations in higher education is not a guarantee for equal access. Research in accessibility in computing education has highlighted the existence of *access differential* (between students with and without disability) and *inequitable access*, indicating variability in how needs are met by existing accommodations and through considerable access labor, which often means students must find ad-hoc solutions themselves [70] and develop alternative workflows to create access [42]. Students with disabilities have long had an active role reshaping their educational environments - Berkeley's based Cowell students famously subverted hierarchies of professional expertise creating the Center for Independent Living in 1972, putting disabled people in the role of service providers [35]. Lastly, the concept of *access intimacy* by disability activist Mia Mingus refers to the "hard to describe feeling when someone else 'gets' your access needs" [56] creating closeness and safety, facilitating emotional connection and making it easier to ask for support and help. Applied to CSCW, this concept allows us to center emotional safety, intimacy and trust in cooperative organizational practices for equal access.

3.3 Accessibility and neurodiversity

A systematic review of research on neurodivergent students in higher education reveals that studies typically focus on dyslexia, autism or ADHD and have been conducted mainly in English-speaking countries [20]. The review shows that many higher ed institutions *"appear to be neurodiversity 'cold spots' despite the existence of support services; the dislocation maintained by low levels of staff awareness, ambivalence and inflexible teaching and assessment approaches"* (ibid p.22). This research shows that barriers are organizational and structural as well as attitudinal. One example is *multimodal inhospitality,* which "occurs when the design and production of multimodal texts and environments persistently ignore access except as a retrofit" is a concept that invites us to analyze how exclusionary norms

and assumptions might be carried on through interaction in the classroom and in various services [91].

CSCW research on dyslexia suggests that understanding and supporting the invisible labor of access is a necessary pre-condition for improving accessibility [88]. We extend this research by providing empirical evidence from a geographical area that is typically less in focus and by broadening our focus to neurodivergent identities that are usually not examined. To account for the fact that many neurodivergent individuals identify as chronically ill, and neurodivergent identities have overlapping characteristics with chronic illness (such as variation in ability and energy fluctuation) we build upon recent HCI work by Mack et al. on chronic illness and accessibility. Their work creates a helpful framework to (i) move beyond medical needs by centering access needs and individual agency; (ii) center fluctuations and variability of ability and (iii) consider both sociopolitical barriers and the reality of physiological impairments together [47].

There have been different approaches to accessible practices in higher education. Universal Design for Learning (UDL) and the use of technology for planning, reading, writing, communicating, and collaborating prove hugely beneficial in promoting inclusivity [20] [30]. However, for such efforts to unfold and be effective, institutions need to both increase know-how and awareness around these approaches and be ready for organizational change.

4 METHOD

4.1 Data collection and participants: a multi-stakeholder approach

This study was framed by an exploratory qualitative research approach, combining semi-structured interviews (n=26) and document analysis, for instance of policy documents related to disability support.

4.1.1. Semi-structured interviews

We used a multi-stakeholder approach, interviewing 18 neurodivergent students enrolled in Computer Science BS or MS programs at three Danish universities (see Table 1 for details) and 8 university employees: 3 administrative officers (disability office and counselling) at two Danish universities; 2 student tutors in Computer Science; and 3 teachers working in three different Danish computer science department, with at least a decade of teaching experience in CS (see Table 2 for details). Note that individual demographics are not reported to protect our participants' identities. In the Results section, we refer to the three computer science departments as University A, University B and University C.

We recruited student participants through university social media platforms and with the help of university disability service officers. We adopted an expansive definition of neurodiversity: our study included students with autism, dyslexia, ADHD, a combination of autism/ADHD and autism/ADHD/dyslexia, cyclothymia and students whose neurodiversity was produced by illness or experiences resulting in neurological conditions, such as students with CPTSD (Complex Post-Traumatic Stress Disorder), chronic illness (fibromyalgia) and Persistent Post Concussion Syndrome (see Table 1).

Table 1. Aggregated Participant Role and Information: Neurodivergent Students

Education type		Self-reported disability identity		Gender		Ethnicity	
Bachelor program	14	Autism	3	Women	9	White	16
Master program	4	Dyslexia	4	Men	9	BIPOC	2
		ADHD	4				
		Autism and ADHD	2				
		Autism, ADHD and Dyslexia	1				
		Fibromyalgia	1				
		Cyclothymia	1				
		PCS[2]	1				
		CPTSD[3]	1				

Table 2. Aggregated Participant Role and Information: University Staff

Role		Gender		Ethnicity	
Disability officer	3	Women	5	White	8
CS teacher	3	Men	3	BIPOC	0
Student tutor	1				
Disability student-mentor	1				

All our neurodivergent student participants had formal diagnoses.

All interviews were conducted and analyzed by the first author. Interviews took place either in person or online, according to the personal preference of our research participants, and they were recorded with a digital audio recorder. Interviews' duration ranged from 40 minutes to 1 hour and 40 minutes, with an average length of 60 minutes. We used four different semi-structured interview guides: one specifically designed for neurodivergent students, one for teachers, one for disability officers, and one for tutors/mentors, in order to gain insights on the experience and perspective of each group in relation to neurodiversity, access barriers and current access practices. Interviews with students were inspired by the life story interview (LSI) approach [5], focusing on a holistic understanding of their trajectory as students of computer science (from their choice of the study program to their future career goals) and the history of their diagnostic process. Students' interviews protocols included questions on their everyday study and social experience and on their interaction with disability support systems. Interviews with teachers, disability support officers and mentor/tutors covered their professional trajectory in their role, their expertise and work with neurodiversity and accessibility (if any), and questions on how they supported neurodivergent students. They further included questions on their perspective on neurodiversity and access in Danish higher education.

Student interviewees were offered compensation for their participation in the study, whereas employees did not receive any compensation, with the exception of the student

[2] PCS: Persistent post-concussion syndrome.

[3] CPTSD: Complex post-traumatic stress disorder.

employees. We strived to focus on accessibility when planning and conducting the interviews [49], by providing clear communication in advance, reminding our participants that they could ask for breaks anytime. We let the participants decide whether they would like to prolong or shorten the interview according to their needs (the planned time was 45 minutes) and they could decide whether they preferred remote interaction or in-person interaction.

All our study participants with dyslexia, one participant with ADHD and one participant with post-concussion syndrome are users of assistive technology. The ATs most commonly used by participants are: screen reader systems, Automatic Speech Recognition (ASR, a speech-to-text technology), Optical Character Recognition (OCR), Emacspeaks, spellcheckers, audio recorder, *software for eye protection,* the Danish library of accessible digital books *(NOTA),* blue light filter and eye protection software. Even though dyslexia is the most commonly registered "impairment" by disability offices in Danish universities, we found significant challenges precisely around the AT needs of students with dyslexia.

4.1.2. Documents

This paper also draws on the study of documents and reports, particularly national policy documents on disability support in higher education and documentation of disability services offered by the national systems. Some of these documents were shared by the disability officers. Insights from these materials have inspired us to critically interrogate the current practices around accessibility in the Danish higher education system.

4.2 Data Analysis

We analyzed data using thematic analysis [12,13] an iterative technique for generating codes, themes and memos from qualitative data. Thematic analysis is a method for the systematic identification of themes (patterns of meaning) in a given dataset, in order to make sense of shared experiences and meanings [13]. This approach is very well suited to uncover behavioral regularities expressed as patterns. Following Miles and Huberman's [57] our analytical approach involved a combination of inductive and deductive (or concept driven) coding. We started with some themes derived from the literature (our conceptual framework) while simultaneously letting new themes "emerge" from the document and interview transcripts. Some examples of conceptual categorization based on the literature, which informed our analytical process, are 'access partners' or 'crip time' (the latter was used as a deductive code, see below).

All interviews transcripts, notes and the policy documents were coded by the first author using the MaxQDA software, using a combination of inductive and deductive coding. We analyzed most disability policy documents and national reports in the first phase of the research process, to be better able to formulate the interview guides. During the exploratory phase of the analysis, the first author created 39 unique codes to summarize the data (e.g., accessibility breakdowns during exams, 'crip time' and pace of education, cultural assumptions on autism), with some sets of sub-codes (e.g. "space and use of AT" under "accessibility breakdowns during exams"). The codes were shared with co-authors for critical discussion and reflection, and finally organized in a set of recurrent "accessibility barriers" in three main thematic areas, as well as local micro-interventions.

5 RESULTS

Our results are organized into three sections. First, we describe how neurodivergent **students encounter structural and attitudinal barriers to access**, **both in the *educational environment* and when interacting with the *disability support system***. This results in additional time and effort required for students to access academic opportunities and make use of existing support services. We have identified three main areas where students' needs are typically invisible and therefore not met: (i) *Assistive Technology Needs*; (ii) *Cognitive/Physical Access Needs* and 3) *Social Access Needs.* These needs are rendered invisible due to a **general lack of awareness and strategic focus on accessibility in the classroom, and to widespread gaps in organizational knowledge creation, organization and sharing in relation to neurodiversity and accessibility**. Disability support services are geared towards students only and do not provide support for teachers, TAs or other university staff in need of support or advice around implementing accessible practices. Information on the number and typology of students with disabilities is siloed (available only within disability support units at each university) and it is not currently shared with staff in CS departments. This is due to the disability officers' concerns with sharing information about 'special categories' of personal data under GDPR regulations, like disability status. In addition, disability support datasets do not include students who do not have a formal diagnosis/medical documentation, or who are unaware of or unwilling to register for disability support.

Secondly, we found that structural and attitudinal **access barriers are intensified by intersecting social dimensions** such as gender, nationality/immigrant status, co-occurring mental health conditions and multiple diagnoses.

Finally, we describe the **bottom-up micro-interventions** for collective access developed by students and their allies.

5.1 Structural and attitudinal barriers to access

5.1.1. Invisible Assistive Technology Access Needs

Assistive technology is designed to help users perform specific functions, but it only works if students are enabled to use it – and that depends on many factors, including the organizational readiness to anticipate and support the use of AT. By interviewing teachers and disability officers, we learned that the information on disability status and specific needs which is provided by students to Disability Services (upon registering for disability support) is unidirectional and not shared with anyone outside of the unit. CS teachers explain they are generally not informed – not even in statistical or anonymized terms - about the students' access needs, and they receive no training or support around neurodiversity, disability or assistive technology. A teacher is typically only informed about access needs when students themselves choose to disclose the information or right before exams, when teachers receive a note about the assistive tech and reasonable accommodations they have been granted. This information gap among university staff creates barriers around AT especially for students with dyslexia – who often use AT regularly and are the largest registered group of students with disabilities. A woman with dyslexia reported that during her first programming exam, an oral assessment, she was surprised to be asked to code on a whiteboard without any spellchecker – the praxis at her

department, unbeknown to her. After evaluating the exam, the teacher explained that she would have gotten a higher grade had she written faster and with fewer spelling mistakes. The student was stunned to learn that staff was completely unaware of the fact she was dyslexic – she registered her disability with the university Disability Services, and assumed the department was informed about her dyslexia and her needs.

Due to a lack of strategic training, disability literacy and information sharing, teachers might not only be unable to anticipate access needs but might say no to the use of assistive tech – even when the request is backed by other stakeholders (i.e. disability officers). Throughout her CS Bachelor, the student explained she was regularly denied the use of any digital (or analog) dictionary during exams, even though she needed the accommodation - which was recommended to her by Disability Services. She explains:

> "Every time I go to an exam, I have to apply for getting this dictionary. And I only got them to approve it once in all 3 years of my Bachelor (…) It's because the Board of Studies think I will cheat." (Student, university A, dyslexia)

Students' applications to the Board of Studies for extra accommodations during exams (which often include extra AT) are a routinized practice. But Board of Studies members – typically teachers – also lack training and literacy around AT and disability and might say "no" because they suspect students of cheating or laziness. In our data, accessibility breakdowns during exams are among the most common and frequent barriers. In all cases they are related to knowledge sharing gaps or glitches, like examiners not providing the requested accessible files; exam proctors ignoring access needs; automatic timeouts shutting down digital exams long before the granted time extension; double booking of exams or exams scheduled too close and not taking into account the extra time granted to students with disabilities. These breakdowns led to students failing exams, getting low grades, or having to reschedule the assessment.

Everyday integration of AT in the CS classroom also presents challenges. Screen readers provided by the Danish disability services are not configured to read math formulas. In classes where Emacs is the recommended IDE, screen reader users are encouraged to use Emacspeak but are left alone in figuring out how, increasing the learning curve for software adoption, which adds to the task of learning how to code. Due to lack of CS domain-specific accessibility knowledge, troubleshooting and finding accessible alternatives were left to the students. Our data also show how space requirements for assistive tech were not considered and anticipated by some of the institutions. A student with dyslexia reported several months of delay in getting an exam room where he could use speech recognition systems for coding, and a very complicated and time-consuming protocol to find a separate room to do group work, a common activity in all CS classes:

> "It's quite a puzzle…I was having problems getting a room to do group work, because I have to speak to the computer. I asked at the Disability Services and she said, go to the student counselors… and the student counselors say (…) talk to the Dean of Education, and you have to ask the Disability services for a special headset. And you know, this, this will take months (…) why is it such a problem? I cannot be the first person talking to a computer!"

(Student, university B, dyslexia)

This quote is one example of a common experience among our interviewees – we found that **pathways to accommodations very often required excessive access labor on the students' behalf**. Due to a lack of clear communication at the department level, and to a fragmented landscape of support across multiple service providers, seeking accommodations led in many cases, paradoxically, to added stress and less time available for studying.

Lastly, from our interviews with teachers and students we found that **accessibility as a subject is not yet well integrated in the CS curriculum** in any of the CS institutions we examined. Nevertheless, many of the study participants expressed interest in projects or careers related to accessibility and assistive tech, often in combination with a neurodiversity focus, as they found meaning and motivation in working in those areas

5.1.2. Invisible Cognitive and Physical Access Needs

Some access needs are more invisible than others. Our interviews reveal that needs linked to cognitive and physical differences – from differences in executive function to fatigue or fluctuation in energy – were often not properly anticipated. In one of the institutions, the webpage on "Accessibility" exclusively refers to mobility and wheelchair access to physical spaces, with no mention of other disabilities. Within Disability Support units, the neurodivergent students' needs are mostly framed within a medicalized framework in which students are categorized according to areas of "functional impairments" (in Danish "funktionsnedsættelser") or "special needs" and offered support with various types of extra accommodations. But accommodations are not enough when organizational practices routinely do not anticipate and support the multilayered needs of students. As this student explains:

> "(For) a lot of the so-called diversity initiatives, you need a ticket to get in, you need a diagnosis, the universities aren't just generally inclusive. It's like, we have a small inclusivity program that you can get in if you have the right label! (…) And there are the ones like me and like some of my friends [with autism] who are so well functioning that we usually aren't taken seriously if we ask for accommodations, but we are not well functioning enough to not break down when trying to do what neurotypicals do. We are kind of invisible."
> (Student, university C, Autism and ADHD)

She articulates how the access needs of neurodivergent students are typically not visible from the outside, which can lead to false perceptions and judgments, and can make it difficult for students to express them.

The students' different neurocognitive functioning and their physical needs are often hard to balance with the current tight and rigid pacing of CS classes, the general lack of multimodal forms of engagement, and the intense workload – even when accommodations are granted.

Students with ADHD, dyslexia and brain injury wish for more *multimodal approaches to learning* and *remote access solutions*. All of our interviewees stated that recorded video lectures were among the most useful tools to support their learning. Video lectures allowed students to revise material, support focus by pausing and replaying, and allowed them to

catch up on classes skipped due to fatigue, pain, stress, or social anxiety. A student with ADHD who speaks Danish as his second language noted that recorded video lectures are useful both for focus and language comprehension. *Video-supported learning* is still relatively underexplored in the CS organizations we studied, but many of our interviewees rely on Youtube science comm channels like 3Blue1Brown as more accessible paths to learning Maths and CS concepts. *Remote access and blended learning* are experienced as very helpful, but these approaches to learning were not common organizational practices in the institutions we studied.

We also found barriers in extracurricular and outreach activities. For example, one student reported opting out of the coding camp for women, a free initiative by her university to increase recruitment of diverse students in CS, because the program extended over three long days, which was not a good match with the needs related to her chronic illness. She explains:

> "Is not like they do not want to accommodate us. They just don't know how it is to be sick."
> (Student, university C, fibromyalgia)

In absence of clear guidelines for accessibility, the availability and choice of tools for a more inclusive learning experience are up to the individual teacher. As this teacher explains:

> "I am teaching a programming course (…) At times the students approach me and ask for help with their, you know, the needs they have. So I know for example there is a fair share of dyslexic people. When they come to me, I feel ill-equipped to help them. But I do send them on in the system [of disability support]."
> (Teacher, university B)

The teachers interviewed reported they would appreciate having a "place to turn in" to get support in better addressing or anticipating the needs of students.

Students also wish that bureaucratic systems of disability support offered multiple modalities of interaction. The students wish for a broader range of *remote and in-person* interaction modes, to better suit needs connected to *cognitive differences*, *variations in executive function* and *social anxiety* which are currently not taken into account.

5.1.2. Invisible Social Access Needs

Interdependence is a crucial tenet behind the design and implementation of accessible systems. But in all the institutions we examined accessibility is still largely understood as an individualized rather than collaborative concern. Access needs are currently addressed by allocating "special support" to one single individual – leaving out other relevant social dimensions like the richness of **pre-existing care networks** and the value of facilitating **social support and community building.**

The majority of our interviewees have experienced depression and/or social anxiety at different stages of their study journey, which meant that access partners such as parents or romantic partners occasionally needed to interact with the disability support system. But socio-technical systems are typically not designed so that multiple access partners can interact with services. In our study, these barriers emerged especially in connection with the system for hiring "student mentors", currently outsourced to a private third-party

welfare service organization. Mentors are students hired to support students with "functional impairments" and perform tasks like giving support in scheduling or organizing academic activities. They are discouraged from becoming too close to mentees or their families. This can result in care networks being disrupted: An autistic student described his shock and disappointment when he learned that his mentor was fired after initiating an interaction with the student's mom (breaching the company's protocol) even though this gesture was in the student's best interest, due to his temporary inability to interact during a period of depression and fatigue.

We found that the system for hiring student mentors presented further challenges. Students with social anxiety and/or autism felt uncomfortable navigating the process of hiring their peers – since it is the student's task to conduct job interviews, some of our interviewees withheld from seeking this accommodation because they felt uncomfortable and unsafe with the process. As this student diagnosed with Complex PTSD explains:

> "You need to go interview people and then basically hire them yourself. How could I do that? I mean I can't even study right now, because I'm so stressed out. So to read applications by people and then go and talk to them when I have social anxiety about strangers when I talk about things that I'm vulnerable about... So I just didn't really get started. But I do honestly think that that would have been the best thing for me."(Student, university C, Complex PTSD)

The vulnerable and intimate process of verbalizing emotionally distressing or sensitive information to untrained peers created barriers for students, who opted out of this system of support. We found that trauma-informed approaches are not commonplace but could be highly beneficial in the training of peer-mentors and in the design of peer-mentoring systems, breaking down barriers and facilitating effective and safe networks. A trauma-informed approach integrates knowledge about trauma into organizational practices and policies, centering trust, safety, choice, collaboration and empowerment [37] – when systems of care are informed by trauma, people using services have an active voice in deciding how they will receive the services.

Many students stressed that **social stigma and lack of literacy around neurodiversity and mental health are significant barriers to social belonging and to mobilizing support** (see examples in Table 3). Many neurodivergent students have encountered negative and prejudiced attitudes at the university, in their previous studies, while interacting with social workers, and in job interviews – students with dyslexia, ADHD and autism in particular. Awareness of social stigma plays a big role in how comfortable the students are in seeking support or stating their needs - disclosing one's diagnosis does not always feel safe. Some interviewees reported lying about the fact that they had support teachers or made sure to "hide" when they met with them, for fear of appearing "stupid". The current medical terminology adopted by systems of disability support ("functional impairment") is perceived by some as stigmatizing and stressing a deficit in the individual, which makes it less appealing to seek support.

Table 3: Examples of Access Barriers

Assistive Technology Access Barriers
1. Teachers are unable to support or anticipate assistive tech needs if not routinely informed of students' access needs.
2. Board of Studies can deny the use of AT during exams.
3. Examiners and exams proctors forget to bring accessible exam files for screen readers users.
4. Automatic timeouts shut down digital exams before time extension.
5. Screen readers provided by disability services are not domain-specific.
6. Space requirements for the use of AT during group work and exams are not anticipated.
7. Hard to find domain-specific support for accessible software.
8. Repeated and time-consuming tasks require considerable access labor.
9. Delays in delivery of accommodations and AT.
Cognitive and Physical Accessibility Barriers
1. Staff and teachers are unable to properly address students' needs when they lack literacy on neurodiversity and cognitive accessibility.
2. Teachers lack support on how to implement accessible practices.
3. Intense workload and rigid pacing of CS classes are hard to reconcile with fluctuations in energy.
4. Remote access and recording of lessons often not available.
5. Lack of multimodal approaches in the classroom and in the bureaucratic system of support.
6. Outreach and extracurricular activities not designed with neurodiversity access needs.
7. Lack of flexibility in providing both accessible remote access and in-person meetings.
8. Excessive access labor in seeking accommodations adds stress and takes time from studying.
Social Accessibility Barriers
1. Access partners are not enabled to interact with some disability services.
2. Unstructured or unpredictable schedules and programs (in teaching and social events presentation).
3. Length and pacing of social and outreach events hard to reconcile with fluctuations in energy and multiple disabilities.
4. Stigma around disability makes it hard for some to disclose their needs (and their diagnosis).
5. Experiences with direct discrimination in and outside the university.
6. Stigma around mental health.

5.2 Intersecting social dimensions intensify barriers to access and access labor

The intersection of neurodiversity with other dimensions like gender, nationality/immigrant status, socio-economic status, co-occurrence with mental health conditions and/or other diagnoses intensified existing barriers and required additional access labor from students.

Gender impacts the likelihood of being underdiagnosed or diagnosed later, as many of our women interviewees with autism and ADHD mentioned regarding their own personal experience. The gender barrier is significant, since the lack of a diagnosis or its delay

prevents access to accommodations. Secondly, some of our women interviewees with autism also reported "masking" quite frequently (suppressing certain behaviors related to autism) in order to fit in, and explained how costly that was in terms of their motivation, energy, and well-being. Unlike their male counterparts, the autistic women in our study also reported encountering more incredulous reactions by peers upon disclosure of their diagnosis, being told they don't "look autistic". In addition, gender minorities in CS are more likely to experience gender-based discrimination and microaggressions: Two of the women in our study reported negative experiences with the widespread culture of sexism they encountered in their department.

Immigrant status might mean either delay or lack of access to disability support. According to current regulation, to receive disability support one must "Be a Danish citizen or, according to international agreements, have the right to support on equal footing with Danish citizens (for example, be an EU or EEA citizen) or be on an equal footing with Danish citizens" [15]. An immigrant student who partook in our study has reported several months of delay in the allocation of her accommodations.

Having ***multiple diagnoses, or more complex access needs*** renders some of the challenges encountered more complex, as access labor increases accordingly. Parental or caregiving status can similarly add challenges due to extra effort and time devoted to caring for someone else – therefore less time and energy to devote to access labor, as one of our research participants, a student with small children, reported.

Socio-economic status is also a variable that influences equal access. Even though Denmark offers universal healthcare, there are extensive delays in the public mental health system - some of our interviewees have chosen to pay high fees for private medical diagnoses to avoid delaying their accommodations for several months. Several students also reported paying privately in order to be able to study on equal footing with their peers. This included paying for private academic support and for domain-specific screen-readers, and - in one case - paying for multiple doctor's notes each time applications for special accommodations were required, due to the lack of a formal diagnosis.

5.3 Students create collective access with local micro-interventions

Many of our interviewees reported being actively involved in breaking down some of the access barriers, pushing for organizational change in more or less direct ways. In this section, we document some of the many ways in which the neurodivergent students in our study acted as agents of accessibility, generating new knowledge and organizational practices, carving new connections across stakeholders, and working towards collective access in and outside of their CS departments.

Table 4: Micro-interventions

1. From spoon theory to spoon practice
- A CS student with chronic illness became a mentor for social activities, facilitating the creation of inclusive guidelines for social events at her institution (otherwise non-existing) using "spoon theory" as a foundation. Guidelines include precise and clear scheduling, multiple options as alternatives for

energy-consuming activities, alternatives to alcoholic drinks etc. The student stated that by being a mentor, she wanted to give visibility to chronically ill people, with the goal of reducing stigma and misconceptions, explaining that "it's nice for people to see that you can do social stuff when you are sick".

2. Remixing technology for remote and blended access

- A neurodivergent student, together with classmates, created and maintained a Discord channel during the Covid-19 pandemic, to support social connection – the channel became soon popular with teachers and TAs to scaffold various academic activities. Post-pandemic, students used the platform to support new ways to collaborate and do group work inclusive of different needs. One of the autistic students in our study developed a remote work-flow for group work together with his peers, using the Live Share feature of VS Code, while his group mates meet in person, all the while using the Discord voice chat.

3. Research-based scaffolding and practice-based workflow hacking

- A neurodivergent support teacher (a junior researcher tasked with providing academic support to a neurodivergent student) has shared accessibility hacks and alternative work-flow suggestions with their students – cutting down workload, prioritizing mental health, and substituting reading with alternative visual content like videos were some of the adaptive strategies to reduce stress and lower cognitive load.
- A dyslexic student, frustrated by the lack of focus on accessibility, has provided local staff with research-based advice on how to scaffold programming education to be more inclusive for people with dyslexia, encouraging the department to become more inclusive.

4. Slipping Accessibility in the curriculum

- Some of our interviewees have designed project work or thesis around themes related to neurodiversity and cognitive accessibility. Some also expressed the wish to design technology that is helpful for others as part of their career plans.

5. Carving new connections

- A CS teacher, a disability officer and the first author of this paper created a new opportunity for collaboration between disability services and the first-year CS teachers' group – organizing a lecture led by a disability officer on the access needs of neurodivergent students in computer science.

6. Neurodiversity awareness and countering stereotypes

- An autistic CS student reported volunteering as a "human book" on autism in the *Human Library*, a Danish non-profit with the goal of breaking stereotypes and prejudice around marginalized identities. She was hired, among others, by Lego for a talk to management on how they can be more inclusive of neurodivergent employees.

7. Supporting sense of belonging and trust in peer-mentorship

- A queer student-mentor working with a trans neurodivergent student reported intentionally centering trust and LGBTQ+ allyship in the professional relationship with the mentee, extending the organizational tasks with a focus on supporting a sense of belonging.

These micro-interventions represent a variety of collective strategies to break barriers, support and improve collective access and experiment with technology and learning practices in new ways. All micro-interventions are generated from the students' own unique experiences and expertise with being neurodivergent and facing inaccessibility. However, only few of these examples translated into sustainable and long-term organizational change, as many of the student's efforts were not actively integrated by the CS department practices or could not have a direct impact on changing rigid bureaucratic practices. Unequal power relations translate into differential levels of influence in shaping organizational change. But when the micro-interventions were rooted in organizational support and grounded in some awareness and strategic focus on accessibility, they resulted in sustainable organizational change: micro-intervention 1 and 5 resulted in new inclusive guidelines and new institutional collaborations respectively. They were successful because they had full institutional backing and were co-created with people in formal positions within the universities. Micro-intervention 6, by the stigma-awareness student volunteer, also had a wide reach besides being sustainable, since it is part of a formally organized non-profit.

Although the current fragmented and individualized system of support makes it difficult for many of the other documented micro-interventions to sprout into broad and long-lasting organizational growth toward accessibility for neurodivergent students, they opened up new ways of rethinking and redesigning access locally – and have the potential to inform future practices and relations.

6 DISCUSSION

Our findings illustrate that neurodivergent students in CS encounter a range of barriers to access in their *educational environment* and within *the disability support system.* We identified structural and attitudinal barriers in three main areas: (i) Assistive technology access barriers, (ii) Cognitive and physical access barriers, and (iii) Social access barriers, (see Table 3). Barriers are (re)produced within a fragmented ecosystem that lacks intra- and infra-organizational knowledge creation, organization and sharing about accessibility and neurodiversity. Accessibility in the CS departments included in our study is still organizationally framed as the main responsibility of "special support" services, and the onus of mobilizing support is on the individual student. The expert knowledge of Disability Service officers is siloed: they are not tasked with providing organizational support to teachers or other university staff, neither do they have the resources for it. In addition, disability officers are concerned about sharing data on disability with the departments due to data privacy concerns.

Since current practices do not fully support the multilayered needs of neurodivergent students, they spend considerable time and effort engaging in invisible access labor [11,88] in order to have their needs met. These findings unfortunately confirm existing studies on the existence of barriers to equal access in Danish higher education [78,81] and support previous research demonstrating that universities often act as neurodiversity "cold spots", presenting a wide range of inaccessibility issues [20,30]. In addition, we found that the

current design of socio-technical systems of support can result in the disruption of pre-existing care networks, particularly when the crucial invisible labor of access partners is not anticipated.

Our analysis also opened up questions of stigma, prejudice, intersectional disadvantage as they shape organizational practices, and examined how students creatively improve collective access through micro-interventions, although these efforts are also largely invisible.

6.1 Barriers are multilayered and intersectional

By adopting an intersectional approach to neurodiversity, we extend the current research on neurodiversity in academic settings by emphasizing how factors like gender, immigrant status, mental health - and more – are influential in shaping the experience of students, intensifying access barriers. For example, gendered and racialized patterns of under-diagnosing or late diagnosis [4,69], preclude or delay access to accommodations, which adds to other barriers experienced by historically underrepresented groups in CS [10,21,53]. The women in our study reported more laborious patterns of diagnosis and were diagnosed later compared to the men. In addition, women with autism were more likely to self-report experiences with invalidating comments on their identity ("you don't look autistic") and relied on *masking* more often, in order to fit in, which is consistent with research on gender differences in autism camouflaging patterns [40]. By including the underrepresented experience of people with acquired neurodivergence (developed as a result of trauma, illness, and traumatic brain injury) we highlighted how additional physical symptoms and the challenge of disclosing vulnerable personal information regarding trauma had an influence on the availability of accommodations and the willingness to disclose one's diagnosis in order to find support.

These findings have important implications for the design of socio-technical systems supporting equal access for neurodivergent students. We suggest that institutions adopt an intersectional approach when mapping inequitable conditions, focusing on those stemming from the overlap between different systems of oppression rather than focusing narrowly on only gender, or ethnicity. This can be done by explicitly taking a multidimensional approach to explore issues of inequity in computer science [64].

6.2 Increasing literacy and training to empower change from below

Misunderstandings, knowledge gaps, unidirectional data flows and lack of literacy about disability and neurodiversity contribute to creating multiple barriers, both attitudinal and structural. These findings show that there is urgent need to work strategically with literacy on disability and neurodiversity in universities and in the third-party organizations involved in disability support, to design and facilitate more inclusive environments and socio-technical systems. A good place to start is incorporating structured approaches like Universal Design for Learning (UDL) which is officially recommended – but currently not officially "reinforced" - by the Danish state as a way to make education more accessible [81]. Or following guidelines for cognitive accessibility [25,86] to make more inclusive technical systems. But along with the strategic development of new competences based on research- and practice-based guidelines, we suggest that universities also focus on the opportunity to **empower and support neurodivergent students in creating collective access**. The

Disability Services officers' concerns about sharing data related to disability should also be addressed. Teachers and other staff at the Computer Science departments could benefit from information sharing – statistics on neurodivergent students would make their presence more visibile, and could be used to provide (and argue for) better support. According to Danish GDPR regulations, processing of special categories of personal data - such as disability – might take place for tasks carried out in the public interest. Though public interest is not clearly defined, universities should be able to demonstrate a compelling reason for disclosing statistical data in order to inform accessibility, equity and inclusivity initiatives in the interest of students.

Our study documents how students – and sometimes staff – facilitated change by collaboratively creating **local micro-interventions** to improve access. We see these micro-interventions as foundational in processes of access *knowing-making* [35], as they activate new ways of experimenting with technology, countering stigma and facilitating mutual support. Students acted as *institutional plumbers* [2] getting accessibility knowledge and practices into their institutions. The micro-interventions center values and approaches that are missing in practice: access intimacy [56], an emphasis on research-based methods for accessible teaching, new ways of experimenting with remote access and multimodality, spoon theory, activating new connections and knowledge sharing across siloed units, and anti-stigma literacy. But despite the historically prominent role of students with disabilities in shaping collective access in universities [35] Danish CS students are still largely framed as the passive recipients of parallel systems of bureaucratic support, rendering both their access needs and their micro-interventions invisible in their departments. This is a missed opportunity for growth and change.

6.3 Implications for practice: access grafting

We propose **access grafting** as an approach to rethink and redesign organizational strategies to improve equal access. By grafting, new branches of *knowing-making* are added to existing structures and practices. In order for these ideas and initiatives to spark, grow, be visible and transformed into sustainable long-term practices, branches need to be subsequently *infrastructured* [44] into the hybrid system of organizational artefacts, practices, and policies. To be clear, we are not suggesting that neurodivergent people and their allies should be the main responsible for driving inclusivity and change – as there is already a tendency in academia to allocate practical inclusivity work to minorities, which has negative implications - the so-called "minority tax" [65] and might relegate certain areas of work within the academic service/volunteer domain – rendering them invisible - rather than becoming a core part of the organization's strategy field [2,8]. This means, in practice, that through access grafting organizations must ensure a solid base of literacy and competence development on accessibility; identifying existing organizational units/stakeholders (or create new ones) which can support the growth of bottom-up initiatives by neurodivergent communities and their allies.

Access grafting – the process of artfully integrating new branches of access knowing-making by neurodivergent people and their allies - is grounded on the following principles:

- **COLLABORATION**: Identify and engage multiple *access partners*, which includes teachers, TAs, Board of Studies, disability officers, exam proctors, care networks,

peer-support networks, exam offices, advocacy groups and third-party disability support organizations

- **INTERSECTIONALITY**: Consider and anticipate how *intersecting social dimensions* (gender, international status, socio-economic status, etc.) and *co-occurring mental health conditions* can intensify access barriers and access labor.
- **SITUATEDNESS**: Recognize that assistive and accessible technology are always *socio-technical* in nature, as they are situated into specific contexts, digital and physical spaces, activities and domains. This includes considering local privacy concerns about sharing disability data, for instance, creating awareness about the possibility to process and share statistical information for tasks carried out in the public interest of students.
- **MULTIPLICITY**: Anticipate and value the *multiple skills and access needs* of neurodivergent students, spanning across multiple areas: cognitive, sensory, physical, emotional, and social.
- **CRIPPING THE CLASSROOM**: Be open to experimenting with radically new approaches that center disability and accessibility in teaching, learning and social activities, even if they might challenge normative ways to define and conduct activities in the university.

By centering ***collaboration***, we frame accessibility as work that engages a collective of access partners, rather than framing it solely as "special support" delivered by a few professionals within a parallel bureaucratic system. This involves shifting towards systems and practices that emphasize sharing datasets and knowledge, rather than upholding siloed structures. This also mean designing disability support systems that allow access partners like parents to interact with services and interfaces, supporting the work of existing care networks.

By using a lens of ***intersectionality***, we can design socio-technical systems that take into account the extra burden of access labor shouldered by neurodivergent students with marginalized identities, students with multiple disabilities or more complex conditions, students experiencing stigmatized mental health conditions, and students from less privileged backgrounds. This means, for instance, taking steps in countering stigma around the co-occurring mental health conditions that neurodivergent individuals are more likely to experience.

By recognizing the ***situatedness*** of assistive and accessible technology we avoid one-size-fits-all solutions (like providing generic screenreaders that are not designed for STEM fields) and we anticipate what spaces and resources students with cognitive disabilities need in their everyday life.

By centering ***multiplicity*** we consider the complexity and range of skills and needs of the students, and avoid essentializing each category. This could mean, for instance, becoming more aware of stereotypes around autism and how they impact autistic students, and finding ways to challenge normative understandings of cognitive disabilities.

By ***cripping the classroom*** we can shift epistemic practices and center marginalized topics such as disability and accessibility. We can introduce critical discussions on how norms and assumptions shape the design of IT artefacts and systems – while also opening new spaces for students' creativity and experimentation.

In conclusion, the access needs of neurodivergent students in Computer Science are many and varied – and so are their everyday contributions to creating collective access. Strengthening competence development and literacy on neurodiversity and accessibility in the academy and in disability support organizations is a necessary first step to artfully integrate bottom-up strategies for equal access.

7 CONCLUSION

In this study, we examined the invisible access labor of neurodivergent students in Computer Science in three Danish universities. We show how students are both *contributors and recipients of access and support.* We found that neurodivergent students encounter a range of structural and attitudinal barriers to equal access in three main areas (Assistive Technology; Cognitive and Physical Accessibility; Social Accessibility), which are caused by gaps in intra- and infra-organizational knowledge creation, organization, sharing, and use. We highlighted how barriers to access are intensified by intersecting social dimensions such as gender, nationality/immigrant status, co-occurrence with mental health conditions and multiple diagnoses. Additionally, we found that relevant social dimensions like pre-existing care networks and the invisible labor of other access partners (like family members) are currently not taken into consideration in the design of socio-technical systems of support.

We documented how neurodivergent students actively create everyday micro-interventions that generate and improve collective access, carving new pathways of knowing-making across multiple stakeholders, counteracting stereotypes and caring for each other. Building on these collective efforts as a way to reorient change in organizations, we propose *access grafting* as a strategy to artfully integrate new branches of access knowing-making by neurodivergent people and their allies in our institutions - provided that universities and disability support organizations ground this bottom-up, transformative approach in a more concrete strategic commitment towards equity.

CSCW research has conceptualized the intricacies of cooperative engagements – and identified core concepts such as articulation work [9,68], awareness [32,34] and coordination [31]. However, there is a historical lack of CSCW empirical studies that explicitly consider accessibility and the experience of people with disabilities in cooperative engagements. For this reason, CSCW research has traditionally assumed a normative embodiment when designing and conceptualizing cooperative engagements, downplaying how social norms and power dynamics – combined with disability – shape how socio-technical systems are designed and enacted. Similar critiques have been advanced in HCI [39,67,73] calling for more focus on designing for plurality (of needs, of bodies) against normative understandings of "users". In our study we consider how non-normative individuals (with different needs) encounter systems and organizational practices that require considerable access labor on their behalf, negatively shaping the efforts of articulation work. The notion of access labor (or access work) is prominent in accessibility and critical access studies [35,70,88] and it conceptually extends core CSCW understandings of articulation work. Since access labor is always cooperative - and a multiplicity of bodies with a spectrum of needs exist in each cooperative engagement – access labor is a critical concept that extends the CSCW vocabulary and design practices. This paper pushes towards a broadening of core CSCW conceptual work by proposing access labor as an extension and potential nuancing of articulation work.

ACKNOWLEDGMENTS

We thank all the people who participated in this study. The first author would also like to thank Natalia Avlona, Barbara Nino Carreras, Kellie Dunn and Sarah Homewood for the inspiring discussions and support during the making of this research.

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PART FIVE

CONCLUSION

"We are contaminated by our encounters; they change who we are as we make way for others. As contamination changes world-making projects, mutual worlds – and new directions – may emerge."
(Tsing, 2021, p.27)

Rethinking 'diversity in computing' with an intersectional perspective

This thesis presents an empirical exploration of barriers and opportunities for equity in Computer Science, in relation to gender, race and ethnicity, and disability. The project is action-oriented and is both **norm-critical and norm-creative**. Drawing on feminist literature, CSCW, HCI and critical access studies I highlight how mechanisms of exclusion *and* inclusion in computing education are intersectional and (re)produced through discursive, spatial, and social practices (S. Ahmed, 2012; Dolmage, 2017; Margolis, 2008; Margolis & Fisher, 2002; Shinohara et al., 2020; Yıldız & Subaşı, 2023). Universities have 'routes and routines' (S. Ahmed, 2019, p. 144). With a combination of ethnographic methods, I mapped both the visible and the invisible ones, the functional routes and the ones that are not working. We see for instance how stereotyped narratives flow through students' traditions and spaces (paper 2), and how knowledge and data on disability and accessibility are instead not circulating and accounted for (paper 4).
'Diversity' can be a floating signifier, meaning different things to different people. At our department – as in many other computer science institutions in Denmark - 'diversity' efforts were largely focused on gender equality. In order to move beyond a single-axis approach to 'diversity in computing', I examined barriers to equity with an **intersectional approach** (Cho et al., 2013). As we document in paper 2, stereotyped narratives of who belongs in computer science are gendered *and* racialized. In paper 4 we analyze how the intersection of dimensions like gender, disability, nationality/immigrant status, ethnicity, socio-economic status and mental health intensifies existing barriers to access. Students who belong to historically minoritized groups are more likely to experience marginalizing dynamics (Analyse & Tal, 2018; Gilliam, 2018; Guschke et al., 2019; Hoff & Demirtas, 2009; Uddannelses- og Forskningsstyrelsen, 2022), yet we are still grappling with establishing sustainable ways to anticipate their needs and create more inclusive spaces.

As public institutions, universities are legally obligated to prevent and address harassment and discrimination on the grounds of gender, sexual orientation, race/ethnicity and disability. But these different dimensions are still largely framed with a single-axis approach, and broad strategic framework or guidelines on how to work with diversity, equity and inclusion are missing, creating a fragmented landscape with little support for significant institutional change. Universities retain autonomy to determine how to best enact these commitments: in many institutions – such as my own – the work of preventing and addressing harassment and discrimination is in the hands of few individuals, typically women or people from minoritized backgrounds. Some bottom-up initiatives might find support, some might encounter resistance. It is at the juncture of multiple and dissonant perspectives that efforts towards DEI in computer science are configured. As Unterhalter notes, new possibilities for equity in higher education are always negotiated across multiple scales: from below – with the creation of a fair space for agency and negotiation to sustain processes of liberation; from the middle – with the concrete movement of money, ideas, skills and from above – with laws, regulations and diagnostic frameworks (Unterhalter, 2009). All three levels are intertwined and are situated in material-discursive arrangements. Enacting change towards DEI in computer science settings always involves a norm-critical, dialogic form of engagement across multiple scales.

Cultivating response-ability

As such, this research unfolded through a slow process of ***ongoing formative critique*** (paper 1) in which I collaborated and interacted with institutional partners at DIKU and UCPH. This engagement involved practices of noticing, documenting and negotiating – while also creating or joining many forms of local involvement in DEI efforts. This form of norm-critical feedback was formative because it created critical points of change (Black & Wiliam, 2009) – much in the same way formative evaluations are used by teachers to pinpoint areas for improvement. This approach has created shifts in organizational awareness and the blossoming of a series of ***collective actions***, based on tactics such as *recoding rules, mobilizing and facilitating collaboration, non-compliance, official complaint, play and accessibility walks*.

This dialogic process of ongoing formative critique and the collective actions were forms of response-ability, of cultivating "collective knowing and being" (D. Haraway, 2016, p. 34) through emerging collaborations and a mutual process of transformation.

This research also contributes to new strategies to navigate institutional DEI change in computer science education: ***equity-focused institutional accountability*** (paper 2) and ***access-grafting*** (paper 4). With the first, we propose an approach to better examine organizational traditions and

spaces, and encourage institutions to interrogate themselves on their data practices. In addition, we invite institutions to normalize critical reflection in their core practices, explicitly engaging multiple perspectives. Gender, accessibility, and critical discussions of race and technology are highly invisible on the core curriculum of DIKU, revealing epistemic traditions of CS that are shaped around the technical/social dualism (Barad, 2007; Breslin, 2018; Faulkner, 2000). In line with recent calls for **a more critical computer science education** to recast "computing itself in moral, ethical and social terms" (Ko et al., 2020), I suggest the introduction in the CS curriculum of elements of critical theory and methods focusing on accessibility, disability, race, gender and issues of social justice. There are a growing number of resources available to support teachers and managers in this process of course redesign. (Breslin & Wadhwa, 2015; Burtscher & Spiel, 2020; Frauenberger & Purgathofer, 2019; Oleson et al., 2022). This means more than just changing teaching materials. It also requires revisiting HCI and CSCW methods to facilitate reflexivity around issues of race, disability, gender and class in the design and implementation of research studies (Breslin & Wadhwa, 2014; Harrington et al., 2019; Lazem et al., 2021; Mack et al., 2022; Spiel, 2021a).

With *access-grafting* (paper 4) we propose another strategy to cultivate response-ability by **centering disability expertise and the needs and agency of students with disabilities**. Students with disabilities and their allies are already active in creating collective access in their institutions, as we document in paper 4. Access grafting involves grafting these new branches of knowing-making (Hamraie, 2017) – by which we mean various efforts towards collective access - into pre-existing organizational structures and practices. The approach is grounded on the principles of collaboration (by mapping and engaging multiple *access partners*, rather than seeing disability solely as a 'special support' issue); intersectionality; situatedness, multiplicity and cripping the classroom. But to fully develop and grow, these new branches need to be supported by a strong root system – this involves directing more resources into areas related to disability, supporting disability literacy and creating knowledge hubs to support teachers and TAs in their efforts to provide equitable access to students.

Reconfiguring equity in computing means building contact zones, **tracing the potentialities of entanglements** (D. Haraway, 1988) – which ones can be made stronger? When we examine institutional practices with an equity lens, we find that institutional entanglements might generate what anthropologist Brit Winthereik calls *ontological trouble*, "the experience that within the organization data exist differently as part of different practices" (Winthereik, 2023, p. 3). As

Winthereik argues, data exists as part of different worlds, or ontologies, across the institution – data can emerge as a fact, or in need of context – meaning different things to different people according to the context. This was exemplified by how data on disability collected by SPS officers is siloed, due to GDPR concerns (paper 4). A student with dyslexia assumes that if she fills in several forms to document her disability when registering for support through the university's SPS unit, the information will be shared with her teachers - so that they are aware of her access needs (as was the case in her high school). Teachers also wish they were informed about their students with access needs. But in practice, the information is treated as the property of the individual, who must be guaranteed privacy under GDPR rules, and not shared – not even in statistical form. Meanwhile, students with disabilities live the paradox of having their privacy protected by GDPR, but at the same time regularly have to disclose their disability with teachers and TAs in order to advocate for support. Another example of ontological trouble is the case of the harassment complaints that are sent to the student counselors, but not archived or categorized because not seen as 'data' that could be relevant towards DEI efforts. In both cases, **my inquiry generated new dialogue and discussions** with SPS officers and student counselors, sparking reflections at an individual and institutional level. My email asking about how many cases of harassment they recorded led the counselors to change their registration system, creating a new category specifically regarding harassment. My collaboration with SPS Disability Officers during this research resulted in an ongoing dialogue, and generated strong mutual interest in developing new data practices. According to Danish GDPR rules the processing of special categories of personal data (like disability) might take place if tasks are carried out in the public interest. Defining what we mean by public interest and advocating for better data practices will here be the institutional task to undertake, since Denmark currently lacks a strategy for the collection, analysis and dissemination of data on disability (Disabled People's Organizations Denmark, 2019). Meanwhile, we created the first connection between DIKU teachers and SPS officers, with a teacher inviting a disability officer to present data on disability to DIKU teachers, together with some recommendations, in an effort to support disability literacy.
These cases show the intricacies and potentials of enacting DEI work in collaborative, research-based ways, building on each others' knowledge and agency.

It is my hope that this dissertation will meet the need for new ways of advancing equity in computer science education – with a strong emphasis on examining tacit organizational practices with an ethnographic approach, and by developing new norm-creative to enact response-ability.

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